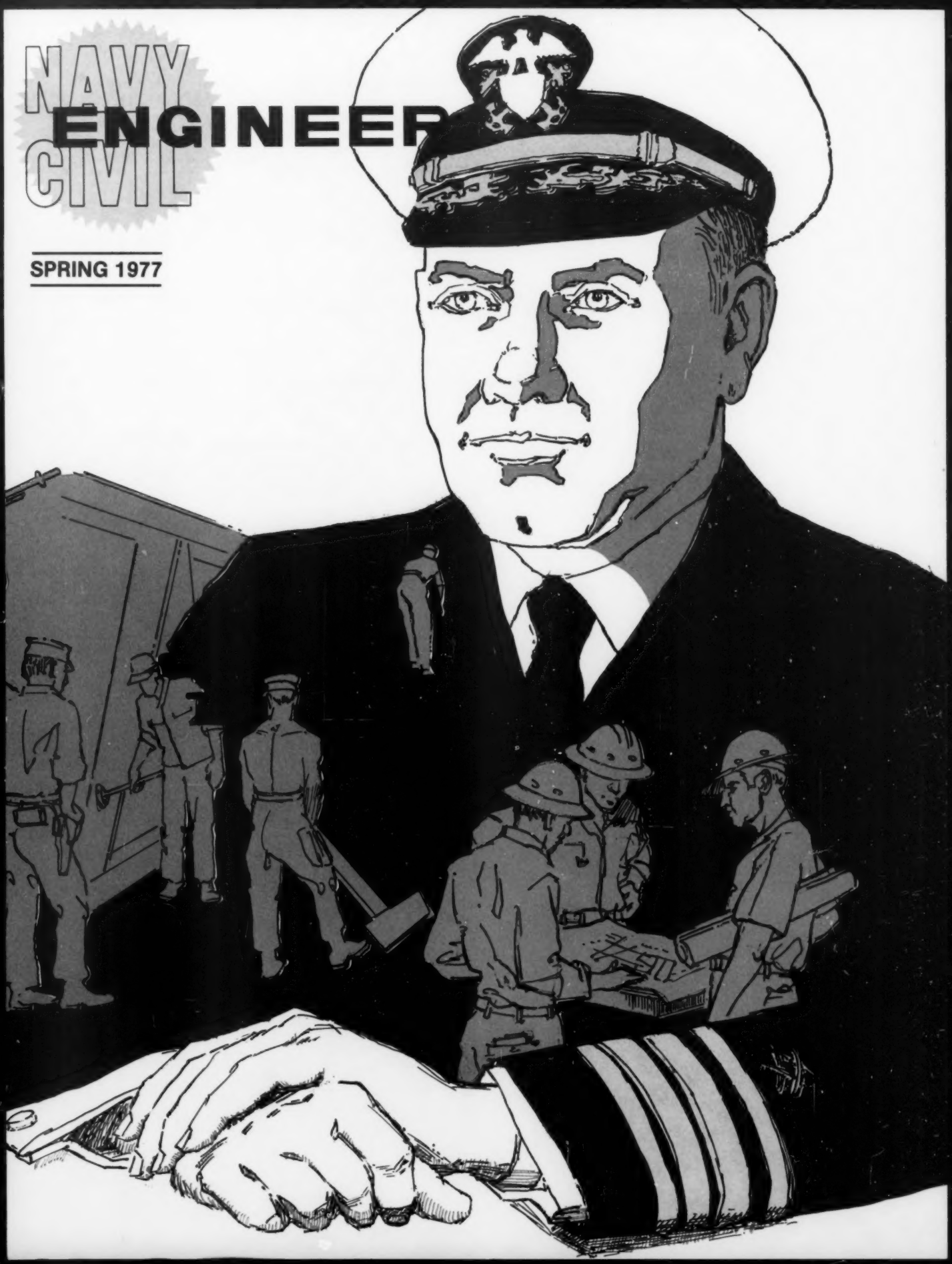
NAVY CIVIL ENGINEER

SPRING 1977



ON THE COVER

Spring 1977 marks the 110th anniversary of the Navy's Civil Engineer Corps — the 135th year of the Naval Facilities Engineering Command — and the 35th of the Navy Seabees. The cover illustrates the three construction entities of the U.S. Navy.

NAVY CIVIL **ENGINEER**

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The metric system is about to change the way we think. Get your meters straight with the article starting on pg. 29.

Does the challenge of dismantling a reactor during January in Antarctica intrigue you? Find out how it was done beginning on pg. 26.

Kings Bay, Ga., A Proposed Major FBM Submarine Base Site

By LCDR BRIAN J. O'CONNELL
EIT, Conn. • Alexandria, Va.

The Secretary of the Navy announced Nov. 30, 1976, that the Army's Military Ocean Terminal (MOTKI) at Kings Bay, Georgia was the preferred alternative site for a Fleet Ballistic Missile (FBM) Submarine Support Base for the Atlantic Fleet. The announcement indicated further studies, mainly the Environmental Impact Statement (EIS), would be made during 1977 to determine if Kings Bay is the best site for the future base. If the existing Army terminal can be converted to Navy use, and if Congress authorizes funding to develop it, this facility will play a major role in the Navy's future.

STRATEGIC SUBMARINES

Strategic submarines (SSBNs), as opposed to attack submarines (SSNs), are armed with fleet ballistic missiles (FBM) and form one of three elements of the nation's strategic defense "triad." Other components are land-based intercontinental ballistic missiles (ICBM) and Air Force strategic bombers. With its mobility and ability to patrol undetected throughout the world's oceans, the FBM submarine could be considered the nation's first line of defense.

In the late 1950s, the Navy launched its first FBM submarine, the USS George Washington (SSBN 589). This nuclear powered submarine carried 16 nuclear tipped Polaris missiles, each with a 1,200 mile (1,940 Km) range. The Polaris system was progressively refined with the A-2 (1,500 mile-2,425 Km) and A-3 (2,500 mile-4,020 Km) missiles developed in the 1960s; expanding the operating areas of the submarines and further reducing likelihood of detection by an enemy.

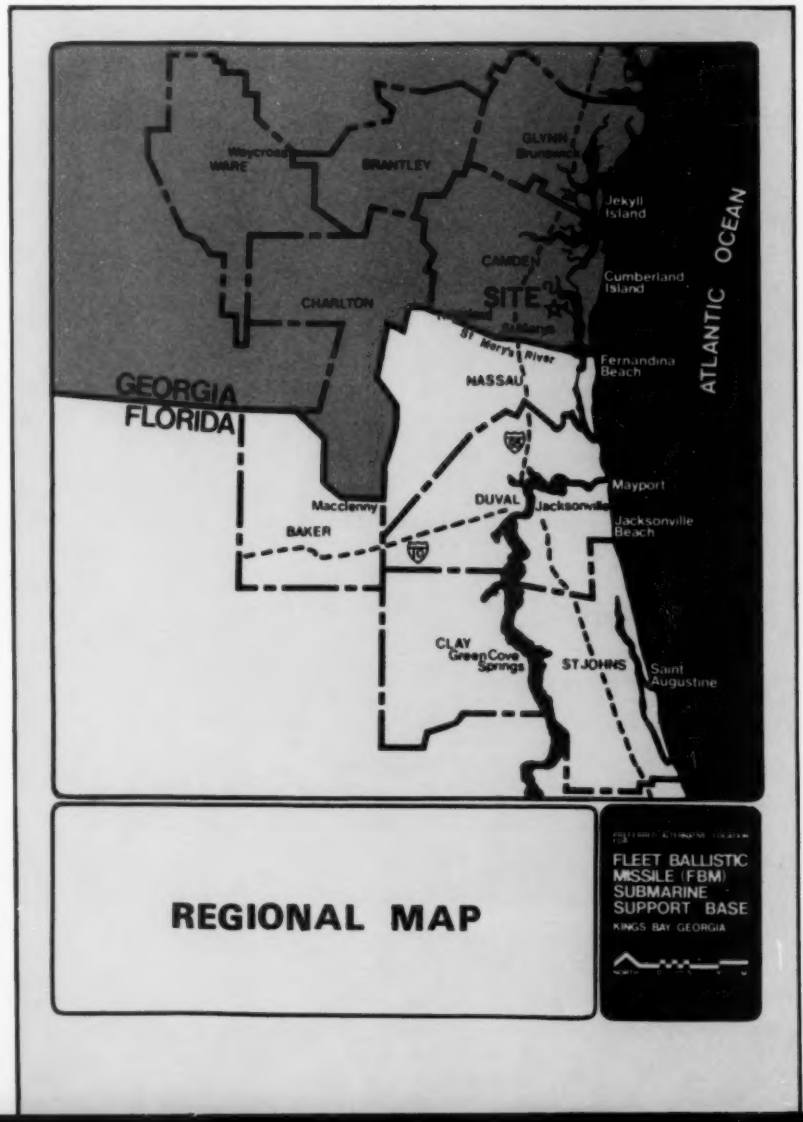
The Poseidon (C-3) missile was introduced in 1971 with the same range (2,500 miles-4,020 Km) as the A-3, but with multiple-independently targetable (MIRV) warheads. Thirty-one of 41 FBM submarines have been fitted with C-3 missiles while one squadron has A-3 Polaris missiles. A-1 and A-2 missiles are no longer in our inventory.

TRIDENT PROGRAM

FBM submarines will start to reach the end of their economic service lives starting in the late 1980s and the Navy is developing a modern replacement strategic undersea-launched missile system (Trident). In addition to a larger, quieter, more technologically advanced submarine, the Trident system will feature the Trident I (C-4) missile which will have a 4,000 mile (6,475 Km) range.

As most Civil Engineers know, a major dedicated Trident Submarine Support Base is being built at Bangor, Wash., by OICC Trident. That base will accommodate one squadron of ten Ohio Class Trident submarines. The first submarine will arrive in 1979. The base has the further potential to homeport two squadrons for a total of twenty boats if Congress authorizes them.

Further, a Trident II (D-5) missile, of as yet undetermined range, will be added to the Trident submarines in future years. Trident I missiles are now undergoing first test launches at Cape Canaveral.



The Ohio (SSBN 726) is under construction by the Electric Boat Division of General Dynamics at Groton, Connecticut.

C-4 RETROFIT

In addition, ten Poseidon submarines in the Atlantic Fleet will be "retrofitted" with the longer range Trident I missiles starting in 1979. This C-4 retrofitted FBM submarine is one of the factors in the need for a new Atlantic submarine support base. With the Trident I's larger quantity of missile propellant, there is a larger explosive-safety-quantity-distance (ESQD) generated from the combination of submarine tender and those submarines alongside during maintenance and replenishment.

Because DoD explosive safety rules preclude inhabited buildings within the ESQD arc, there is not enough real estate at NWS Charleston, the only SSBN refit site on the east coast. Overseas refit sites in the Atlantic are at Holy Loch, Scotland and Rota, Spain. Crews are homeported at New London and Charleston.

REDEPLOYMENT FROM SPAIN

A second event leading to the need for a new east coast refit site was the 1976 Treaty of Friendship and Cooperation between the United States and Spain which calls for the redeployment from Spain of ten SSBNs, a submarine tender (AS) and floating dry-dock (ARDM) by July 1, 1979. The air station and logistic base at Rota will remain.

CNO STUDY

To plan for the redeployment from Spain and retrofit of C-4 missiles in the squadron, the Chief of Naval Operations in 1975 formed a flag level SSBN Strategic Submarine Refit Siting Steering Group to select a site for the squadron. The Strategic Systems Project Office (SSPO) was to conduct the study in conjunction with CINCLANTFLT and with support from NAVFAC.

The study considered all potential sites on the east coast and redeployment of the remaining overseas squadron at Holy Loch, if needed; or future introduction of Trident or later design submarines to the Atlantic Fleet. As indicated, only one Trident squadron is authorized for Bangor homeporting, but with the Polaris boats phasing out in the 1990s, it is prudent to consider expansion potential even though the current requirement calls for only one C-4 retrofitted Poseidon squadron at the new site.

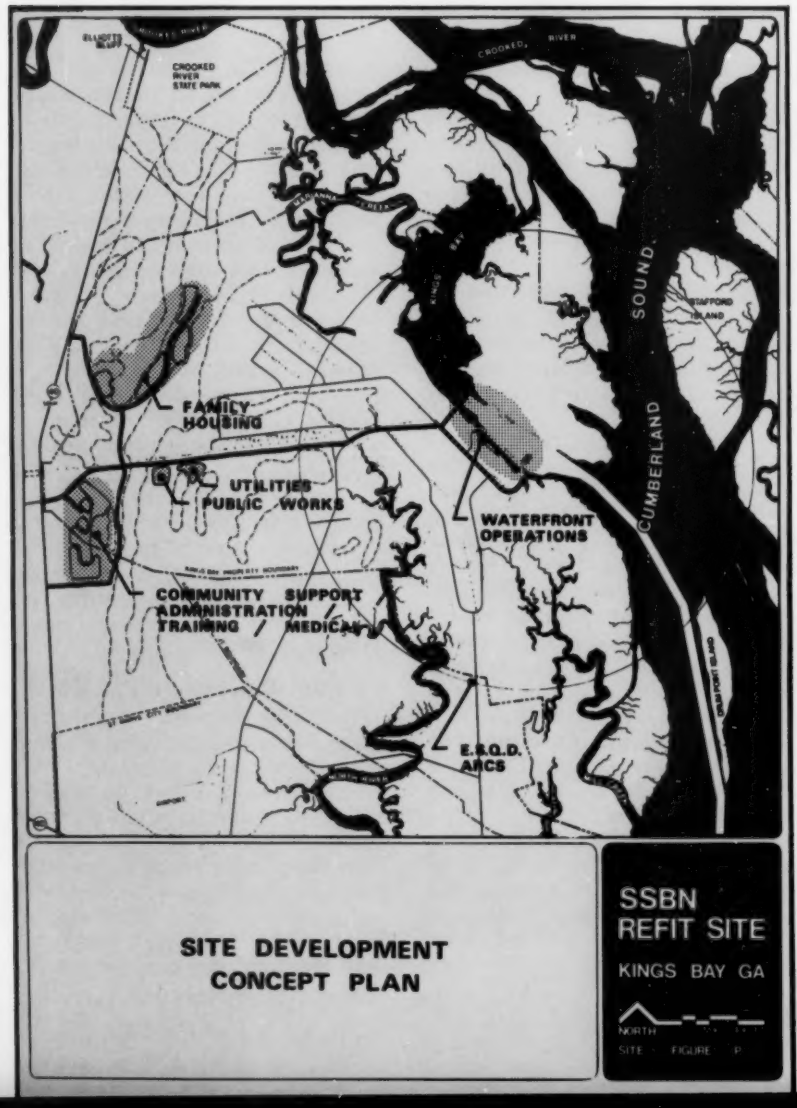
STUDY PROCESS

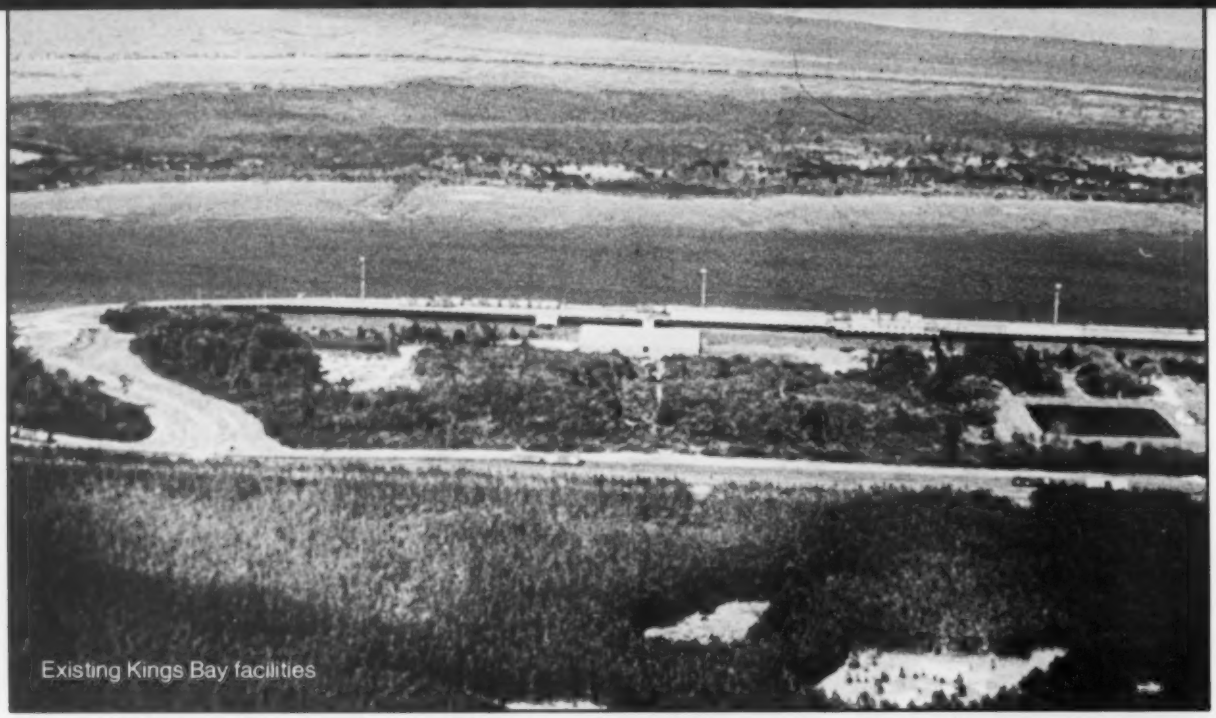
The study then was to consider the initial requirement of one tender supported C-4 squadron, referred to as T-1, as well as a second tender supported squadron, T-2, and one or two squadrons of Trident submarines (A-1 and A-2) with the Trident II missile.

The Trident support concept differs from the tender supported C-4 retrofitted squadron in that the larger Trident submarine has permanent facility support ashore vs. floating assets at the current refit sites.

The Trident base at Bangor has explosive handling wharves, refit piers, permanent drydock, refit industrial facilities, missile assembly, maintenance and storage (SWF), an off-crew training complex, a host of technical support facilities and greater requirements for bachelor and married housing since Trident crews are homeported at the refit site. The Bangor base will eventually involve over $700 million in facilities and indicates the scale of a similar base on the Atlantic Coast.

The study then called for assessing the potential of some sixty Atlantic Coast ports to accommodate any of the four development scenarios (T-1, T-2, A-1 and A-2) with the only certain requirement being T-1. Progressive development could evolve from T-1 to T-2 or A-1 and ultimately A-2 if National Security Policy dictates and Congress agrees. The timing for Trident basing is in the late 1980s





Existing Kings Bay facilities

through 1990s depending on submarine construction, SALT talks and many other variables.

SITE SELECTION

Potential sites were considered in terms of development cost, operational suitability, explosive safety requirements, environmental impact and expansion potential. Many sites were quickly ruled out because of major problems with one or more factors.

ENVIRONMENT

It is good to recognize a new factor in the planned development of a base or expansion of an existing base — the environmental impact consideration. Cynics note the development of a whole sub-industry of lawyers and environmental scientists who specialize in the ubiquitous Environmental Impact Statements (EIS) which seem unreadable and are measured by the pound.

The Navy has painfully learned many lessons about the need to consider properly the environmental impact of its actions. To avert any obstacles caused by environmentalist objections to the base, the Navy placed heavy emphasis on ensuring strict compliance with NEPA, elevating environmental considerations to the same level as operational and other site selection factors. This was considered "good news" to facilities planners who like to consider the environment an integral part of good master planning and base development.

The EIS was thus looked upon as an opportunity to affirm that premise rather than as a threat to progress. An EIS costs money if it is to be done in sufficient depth to be valid and useful. Early in the study process NAVFAC hired an environmental consultant to provide an environmental impact assessment of each site. After site selection, the consultant could be retained to prepare an EIS for site development as well. The firm chosen was Reynolds, Smith and Hills of Jacksonville, Florida; and two of its subsidiaries, PLANTEC Incorporated of Jacksonville, Florida, and Environmental Science and Engineering Incorporated of Gainesville, Florida.

SITE SELECTION

The CNO Steering Group met in September, 1976, to weigh the pros and cons of five "finalist" sites after determining they were the most promising of the sixty originally considered. The five candidate sites were the former Quonset Point-Davisville Naval Complex, Rhode Island; the Cheatham Annex Naval Supply Depot near Yorktown, Virginia; Naval Weapons Station Charleston, South Carolina; the Army Military Ocean Terminal (MOTKI) Kings Bay, Georgia; and Mosquito Lagoon, north of Cape Canaveral, Florida. All sites were government land with further land acquisition needed for some. All except Mosquito Lagoon had ocean access and all would need some dredging.

Each site had some current mission that would have to be relocated or modified: portions of Quonset are leased by Electric Boat to construct Trident hull components; Cheatham Annex has supply functions and abuts Camp Peary, also an active installation; Charleston has the Weapons Station and POMFLANT activities; Kings Bay is in caretaker status with a contingency requirement for transshipment of ammunition as well as an outlease for commercial use; and Mosquito Lagoon was a NASA area and conflicts with the approach zone for the Space Shuttle landing strip at Kennedy Space Center, were possible. Every site would have varying degrees of socio-economic and physical environmental impact.

The steering group, after carefully considering all factors, recommended to the Chief of Naval Operations that Kings Bay be designated the preferred alternative location and further studies be made before final selection is made in January, 1978.

PUBLIC ANNOUNCEMENT

The Navy Secretary announced Kings Bay as the preferred alternative location on November 30, 1976. The Georgia congressional delegation made a simultaneous announcement in the local area. The announcement was greeted enthusiastically in both Georgia and northern Florida. The terminal has been in caretaker status since 1958 and had been used since then

for Army Reserve summer training and commercial outlease. The prospect of the base being activated for Navy use was viewed as an economic bright spot in the rural southern region that, like many parts of the country, had been in an economic slump in 1976.

Government officials and environmental groups viewed the project with some concern for the protection of the environmentally sensitive coastal marshes, estuaries, wetlands and dunes. Georgia has rich natural resources in the coastal areas. The Navy is keenly aware of this and is closely examining environmental impact in cooperation with federal, state, local, and private officials.

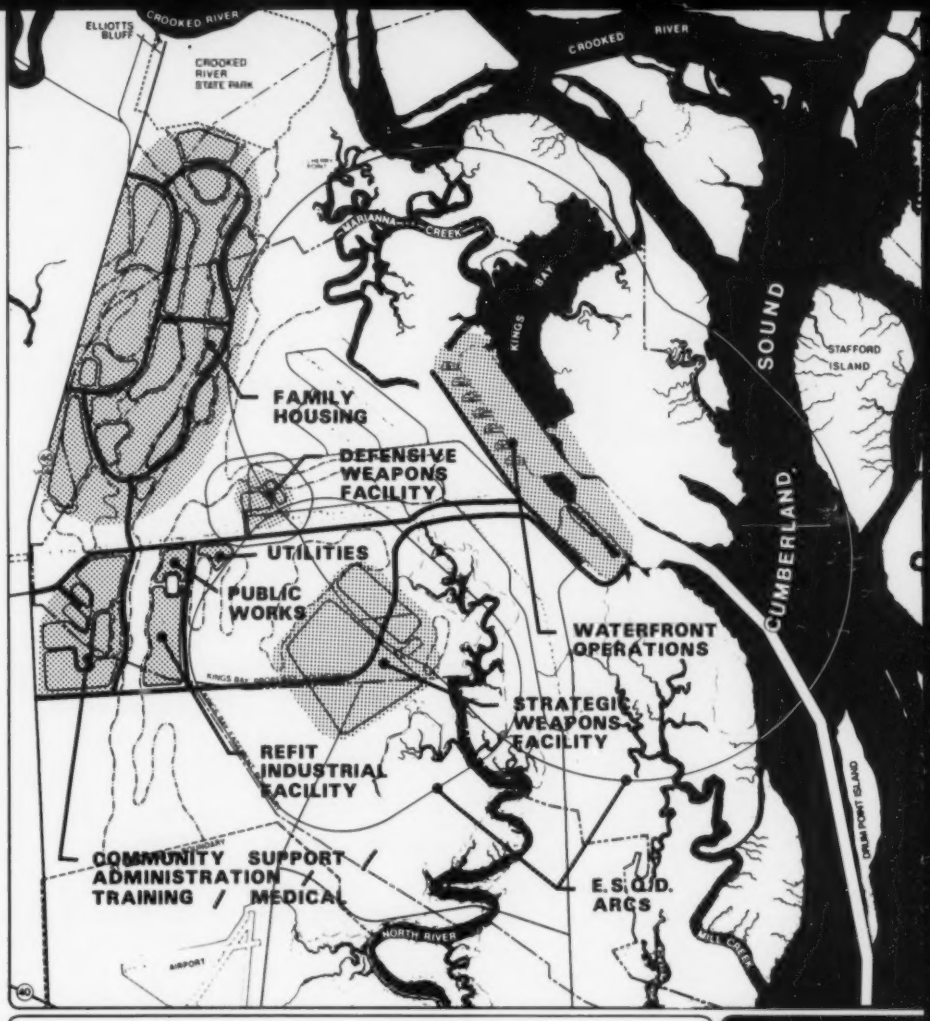
ENVIRONMENTAL PROGRAM

Upon announcement, the Navy and its consultants met federal, state and local officials to outline the environmental process used in site selection and to indicate it would have a draft EIS available in June, 1977. The Navy told public and private environmentalists, such as the Georgia Conservancy, Sierra Club, Audubon Society, Friends of Cumberland Island, Georgia Institute of Ecology and others, of its concern for the environment and sought reactions from them.

This exchange of information, well before the draft EIS was complete, was hailed by environmentalists as a refreshing change from the more customary "arm's length" treatment many projects receive. This attitude did much to advance a rational interchange of questions and data, perhaps fending off future confrontation. The Navy recognizes this does not preclude environmental challenge to the project, but feels this forthright approach can anticipate legal challenges that could disrupt an already tight schedule.

COORDINATION

Navy officials also met other government officials to discuss possible impact on the local economy, municipal services and other regional planning matters. This was in full compliance with the Office of Management and Budget (OMB) Circular A-95 procedures. A-95 encourages regional clearing-houses through which all federal and federally-assisted projects must be coordinated so federal, state and regional planners can determine effects on their respective areas.



POSSIBLE ULTIMATE DEVELOPMENT CONCEPT PLAN

SSBN REFIT SITE
KINGS BAY GA
NORTH 0 1200 2400 FT
SITE FIGURE P

Similar meetings were held with A-95 groups in both coastal Georgia and northeast Florida (Jacksonville metropolitan area). Coastal Zone Management (CZM) officials were consulted. Since the A-95 and CZM programs are relatively new this may be the first project of this scale within the Navy to have been fully coordinated in advance of final selection with A-95, CZM and environmental groups.

With increasing intergovernmental and environmental planning requirements, this project may serve as the forerunner of future project coordination.

PUBLIC INFORMATION

Since the site is relatively undeveloped and a base will bring perhaps irreversible change to the area, it is important to provide accurate information or at least to correct any misinformation. To this end, briefings were held soon after site announcement with the Navy Office of Information (CHINFO), congressional, state and local officials. Liaison is maintained with local officials and press representatives.

(Continued on page 36)

A Solar-Heated Hospital

The sun in Florida will soon do more than grow great oranges!

By RONALD JOHNSON
Reg. Architect, Va.
and DONALD CRIGLER
Architect
NAVFAC HQ

• Orlando, Fla.

Solar energy systems are now being incorporated into the design of the Naval Regional Medical Center here and will provide all water heating, space heating, and up to 100 tons of cooling.

The Naval Regional Medical Center here is in the FY77 Military Construction Program and construction will begin in April 1977 with occupancy expected in November 1979. The center will provide 104 beds and 204,000 square feet (19,000 M^2) of space at an estimated cost of $23,850,000. The design contract is administered by South Div, NAVFAC.

The architectural/engineering firm preparing the design is a joint venture of Rogers, Lovelock, and Fritz, Winter Park, Florida; Rogers and Butler, New York City; Lopatka and McQuaig, Winter Park, Florida; and the Wall Corporation, Washington, D.C. Solar energy consultant is Peter Flack of Flack and Kurtz, New York City.

SOLAR ENERGY COLLECTION

Orlando is an ideal location for efficient solar energy systems. Four climatic and geographic factors affect the efficiency of solar energy systems: daily solar radiation, daily cloud cover, air pollution and air moisture content. Solar radiation is measured in Langleys. A Langley denotes one gram calorie per square centimeter or 3.69 BTUs per square foot measured on a horizontal surface.

Mean daily solar radiation in Orlando is 450 Langleys. Mean daily solar radiation in the U.S. varies from 206 Langleys in Alaska to 568 Langleys at China Lake, California. The mean daily cloud cover in Orlando is about 52 percent. The mean daily cloud cover in the U.S. varies from 19 percent at Yuma, Arizona, to a high of 82 percent in Alaska.

Florida has air pollution standards which exceed federal standards and, therefore, has relatively little air pollution. Orlando does have a high air moisture content, especially in summer.

SOLAR ENERGY SYSTEM

To use the sun's energy directly, three major components must be evaluated and designed for any solar energy system. The first is the *Collector* which collects as much solar radiation as possible and converts it into usable energy — such as heat or electricity.

The second is the *Transfer Medium*, the substance used to transfer converted solar energy (heat or electricity) for use or storage. The third component is *Storage*, where converted solar energy is held for later use.

COLLECTOR TYPES

Presently, the only solar collectors economically feasible for use with buildings are those which convert sunlight into heat. In this category are two different types: *Passive Solar Collectors* and *Active Solar Collectors.*

Passive Solar Collectors integrate the collector, transfer medium, and storage to eliminate as many moving parts as possible. The simplest and most common passive solar collector is a south-facing window. Passive collectors are widely used in homes because they provide relatively low temperature heat at minimal cost.

Active Solar Collectors are more complicated and usually connect the three major components of a solar energy system with piping or ductwork. Active solar collectors provide higher energy output and can be separated into three groups: *flat plate collectors, tracking concentrating collectors,* and the recently developed *evacuated tubular collectors.*

The *flat plate collector* has been used for 30 to 40 years. It is the simplest and most economical of the three active collectors. It features a metal absorber plate over — or through — which a transfer medium passes and an air space formed by glass cover plates and back insulation to reduce conduction losses.

Absorber plates are now made of aluminum or copper coated with flat black paint or black selective surface. The selective surface produces higher temperatures but costs more. The dead air space acts as a buffer between the absorber plate and the outside air, reducing heat losses.

The glass cover plate produces a "greenhouse effect." It allows short wave solar radiation to enter the collector but prevents long-wave heat energy from leaving. Flat plate collectors use both direct and diffused radiation and are rigidly mounted facing south.

To achieve the temperatures needed for solar cooling, flat plate collectors can be augmented with reflectors to increase radiation on the absorber plate.

Tracking concentrating collectors produce high temperatures for special applications. By concentrating the sun's rays on a single point or line, this collector can produce temperatures up to 7,000° F. (3,871°c.)

Concentrating collectors for buildings can heat a transfer fluid to 240°F. (116°c). This is the normal operating temperature of a steam absorption chiller for solar cooling. One drawback of the tracking concentrating collector is that it only uses direct radiation and must always face the sun. This makes necessary a mechanical device which increases initial cost and maintenance substantially.

The *evacuated tubular collector* is a relatively new development which uses both direct and diffused solar radiation and can be rigidly mounted. It features concentric tubes with a vacuum between them. The inner tube, through which the

liquid flows, is coated with a selective surface.

The vacuum between the two tubes is sufficient to eliminate practically all conduction and convection heat losses, increasing efficiency. Temperatures to 240°F (116°c) can be reached for a steam absorption chiller for solar cooling. The cost of this collector is relatively high and it is available on special order only.

TRANSFER MEDIA

Two factors should be considered in selecting a transfer medium. First is local climatic conditions and second, the function solar energy is to perform. The three basic transfer media are: *air, water,* and *heat transfer oils.*

Air, as a heat transfer medium, is used mainly in homes where cost, maintenance, and quickly available low temperature heat are major design factors. Air systems need more installation space because of the large duct space required.

Water is the most widely used medium and, unlike air, needs only small tubes to collect and transfer heat. A water system can also attain much higher temperatures than air. Freezing, however, becomes a major design consideration in more northern climates but can be solved by adding anti-freeze; design of a self-draining system which empties when not in use; or by thermostat controls which activate pumps to circulate warm water to the collector.

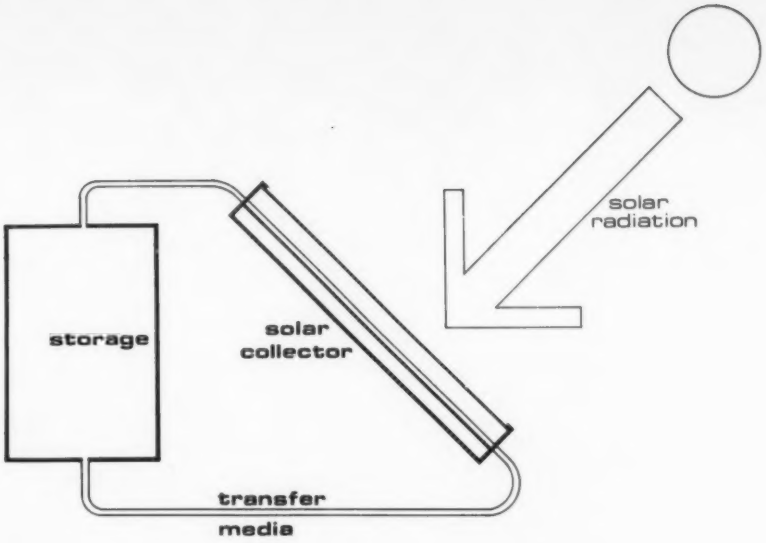
Heat transfer oils have been tested for solar energy systems, but have not met wide-spread acceptance.

STORAGE

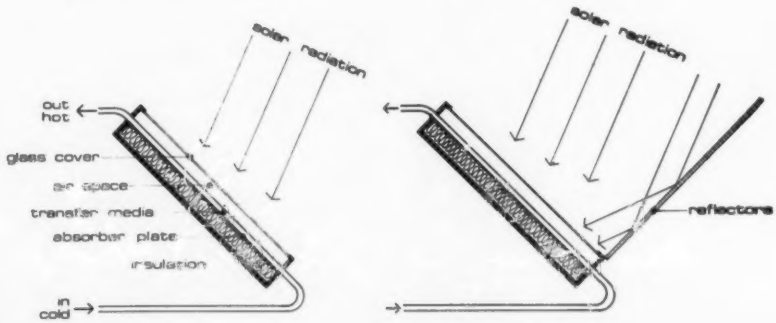
Two types of storage media are now used for solar energy systems: *rock storage* and *water storage.*

Rock storage is common for home use with air as the transfer medium. Rocks do not store as much heat at a given temperature per unit of volume as water and more space is needed to provide the same heat storage capabilities.

Water storage is the most widely used medium because of it's high specific heat. When used with water as the transfer medium, water



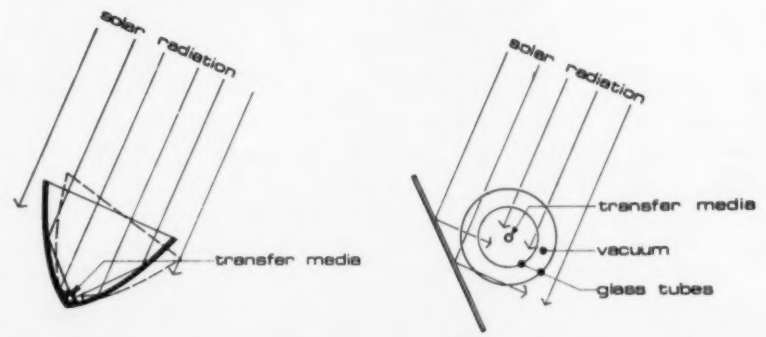
Basics of solar energy systems



Flat Plate — Flat Plate with Reflector

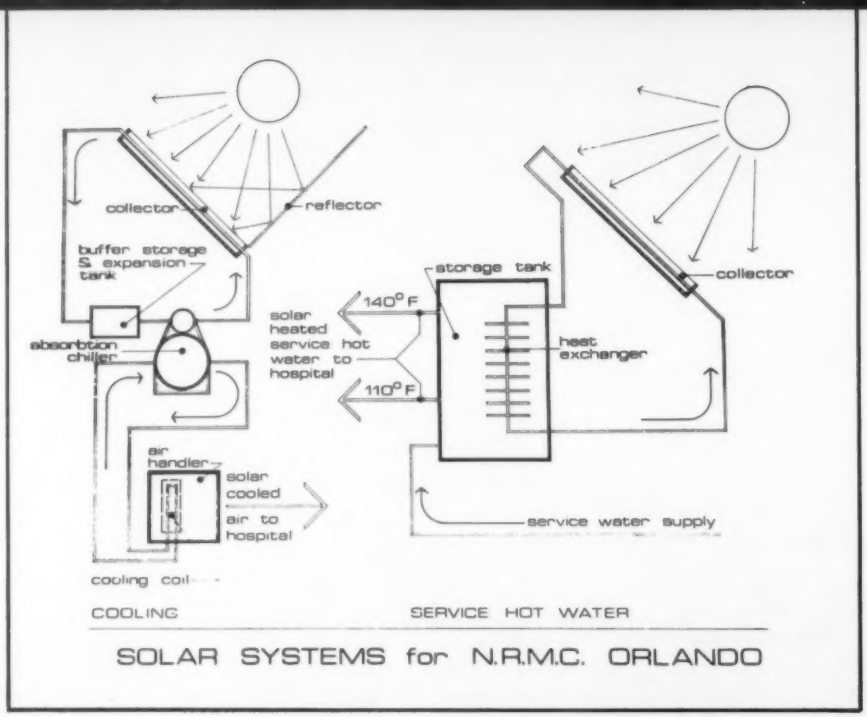
COLLECTOR TYPES

Above and below: collector types



Tracking, Concentrating — Evacuated Tubular

COLLECTOR TYPES



DUAL — Two solar systems have been proposed for NRMC Orlando. One collector serves to provide moderately hot water for heating and normal hot water uses. Another collector augmented with reflectors serves to provide hotter water to be used in an absorption chiller for air conditioning.

storage eliminates the need for heat exchangers, improving overall efficiency.

SYSTEM EFFICIENCY

Solar energy system efficiency is determined by the efficiency of the three main components: the collector, the transfer medium, and storage. Collector efficiency is affected by three factors: radiation received by the collector, temperature difference between the collector and ambient air, and wind velocity.

Radiation received by the collector is affected by reflectivity of the glass cover and the amount of reflected radiation striking the collector. Reflectivity of the glass cover and the amount of reflected radiation striking the collector can be optimized through design for a given collector type.

The reflectivity of the glass cover is determined by the angle at which the collector is mounted relative to the sun. A solar collector should be set perpendicular to the sun's rays during the season of highest energy need. If the collector is to provide heat during winter months inclination should be perpendicular to the sun's winter rays. This minimizes solar energy reflected off the glass cover when energy is most needed.

Reflected radiation striking the collector can increase operating efficiency. Placing a reflective surface near the collector will direct more solar energy onto the collector.

Heat loss from a collector and the temperature difference between the collector and ambient air are directly related. As the temperature difference increases so does heat loss. Two reasons collectors work better in summer than winter are reduced temperature differences between collectors and ambient air, and reduced wind velocities.

Transfer media and storage efficiency are affected by two factors: heat lost to the ambient air, and heat lost in the exchange from transfer to storage. Heat lost to ambient air can be controlled by insulation and reducing the distance the transfer media must travel.

Heat is also lost whenever a heat exchanger is introduced into the system. When heat is transferred from one medium to another, energy is lost in the exchange. Heat exchangers are normally kept at a minimum for most efficient system operation.

NRMC ORLANDO

The system selected for NRMC Orlando will have about 1,500 ft^2 (14m^2) of flat plate collectors for hot water and space heating, and some 8,500 ft^2 (790m^2) of flat plate collectors with reflectors for cooling. Flat plate collectors will be integrated into the center's design.

Flat plate collectors for hot water and space heating will be on the roof of the second floor and slope up to the fourth floor. The third floor is a mechanical equipment floor. Flat plate collectors with reflectors for cooling will be on the roof of the large one-story portion of the building. The transfer and storage medium will be water. Freezing will be prevented by circulating small amounts of warm water through the system.

Flat plate collectors with reflectors will provide temperatures up to 180°f (82°c) for operating a derated absorption chiller. Cost of the solar system will be about $450,000 or 2 percent of the total building cost. Fuel oil savings are estimated at 600,000 to 1,000,000 gallons (23,000,000 to 3,800,000L) over 50 years.

THE SOLAR AGE

The solar energy age has arrived, and technology should be used to develop the maximum potential for use of solar energy. Until recently, low cost energy from fossil fuels has suppressed solar energy development. However, with rising costs and the diminishing supply of fossil fuels, this country is slowly turning to solar energy.

NAVFAC feels the solar energy system proposed for the Naval Regional Medical Center, Orlando is a small, but necessary, step toward use of solar energy systems. Documentation of this system will provide a data base for improving the efficiency of future solar energy systems and, hopefully, go a long way toward improving current solar energy technology.

The Effective Site Visit

A little time invested anticipating trouble may prevent a costly construction delay!

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One problem NAVFAC shares with civilian construction counterparts is the major problem, (soil, geology, ground-water, access, etc.) discovered only *after* construction is underway.

"Why didn't someone think of this before?" is heard in the middle of far too many construction projects. It means men, materials, and equipment have been committed to that project and must now wait on the problem's solution.

With the pressure of idle resources hounding him, a professional can hardy be expected to give any but the fastest answer to the "surprise" problem. For a Seabee project, this mid-job problem may mean delay, extra material costs, or compromised quality.

For a contracted project, the consequences may be delay, re-design, and higher costs with a greatly increased chance of claims and poor future relations between contractor and ROICC.

Why do pre-construction site visits so often fail to uncover problems which should be addressed in plans and specs, or anticipated by the constructor?

There are probably as many reasons as problems, but most will fall into five areas: a meaningful site visit did not occur at all, the wrong man made the site visit, inadequate visit preparation, inadequate information gathered during the visit, or information did not reach the right people in an easily useable form.

The following will address each of these problems and should guide the construction professional to a truly effective site visit.

Figure 1 represents a construction project cycle from recognition of the need for a facility to its completion. A construction professional should make a site visit during three distinct cycle phases. At point A, a construction representative should be included in the decision of "what facility will solve this problem?" He should be a participant in the site selection.

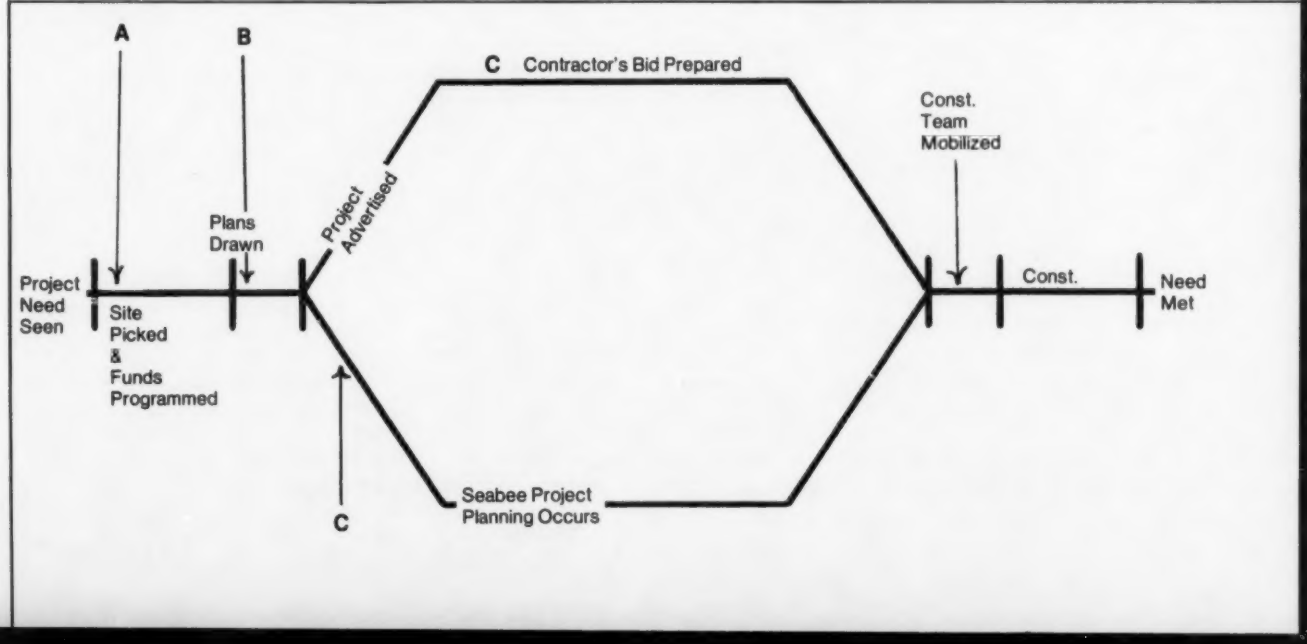
At point B, a construction-oriented designer should visit the site to help answer design questions. At point C, the constructor should visit the site before committing his resources or capital.

At point A, many progressive businesses include their construction staff or designers in important decisions. The Navy enjoys the opportunity of an early construction "chop" at its facility projects by taking advantage of the validation process. Whether validation occurs on-station or at an Engineering Field Division, a *builder* should join the designer in validation.

Looking at point B, the project on a South Pacific base designed "blind" from Hawaii is still too common. The temptation to negotiate site visits *out* of tightly budgeted A-E contracts is tempting, indeed, but experience in the Navy's ROICC and Seabee family proves such a move penny-wise and pound-foolish.

At point C, the contractor who skipped a site briefing or pre-bid conference based on his knowledge of a "nearby" site usually hollers so loudly, it is a wonder his error is repeated by his contemporaries, yet it is.

Navy people, with their responsibility for managing the Navy's facilities business, *owe* the Navy and their fellow professionals a truly effective, construction-oriented site visit during validation, design, and mobilization.



WHO MAKES THE VISIT?

Focusing on visits B and C, from Figure 1, a general answer is, "Send the person responsible for the work." If a design visit is to be made, send the design team, or, at least, the head of the design team. If the visit is for an estimate, or planning a deployment, send the project manager who will actually run the job.

Send the man who will eventually be "boss" on the site. There are many reasons for sending this man rather than a "staff" man. The most important is, of course, commitment to the importance of the visit.

Who often *is* sent on a site visit? Unfortunately, bachelors seem automatically more eligible for site visits than married men. Some bosses use the site visit as a reward (or a punishment). Worst of all, in some cases, the man "who can be spared" is sent.

Send the men who will be responsible for the work.

SITE VISIT PREPARATION

Preparation for a site visit varies with the complexity and importance of the project and site remoteness. Recognizing this, a professional charged with a site visit can follow a plan similar to this one:

- Write a concise statement of the project's scope. This will determine what skills or disciplines will be needed on the "team".

- Have each team member review the particular sections of the plans and specs with which he is most qualified to deal. Have each begin a list of "matters to be explored at the site from his own special viewpoint." For convenience, refer to this collection of materials as the Site Visit Checklist. Items which appear first on the checklist may include demolition to be verified, sitework required, utility connections, etc.

- Review, or choose team members to review, area maps, soil and geological reports, utility surveys, timber surveys, etc., continually adding questions to the Site Visit Checklist.

- Have the team make or obtain rough quantity estimates for site verification.

- Find out if siting is flexible, if, for example, corners may be adjusted to avoid utilities, or to improve access.

- Determine construction time available and seasons of the year.

- Gather and review all commitments to any particular plan, method, piece of equipment, or pool of men. Determine how fixed these commitments are.

- For overseas sites, read the introductory material on the country from a good encyclopedia. This is a case of more information available than is digestible.

- Finally, look to personal preparation. Don't forget shot records, passports, visas, and malaria pills. Remember that orders and an ID card will not take you everywhere in the world. Firm up transportation routes and schedules before you leave.

Having developed a Site Visit Checklist custom-fitted to this job, compare your list to a standard checklist to see if anything should be added. A standard list developed at the Navy Civil Engineer Corps Officers School (CECOS) is at the end of this article. Do not "cookbook" a site visit from the CECOS standard list or any other list, as the one problem which makes this project and this site unique will most certainly not be on any standard list.

By packing a briefcase with the Site Visit Checklist, as modified by a standard checklist; a copy of the plan and specs; and any of the documents his team felt deserved verification at the site, the construction professional is ready for the next question.

HOW TO GATHER INFORMATION

Whether or not more than one person makes the site visit, time-planning will be needed to use on-site time to best advantage. If more than one person goes, assignments should be made to each person.

Data gathering methods fall into seven categories:

- **Talking to:** site neighbors, local PWO or U.S. military personnel, the local project designer, local union officials, prospective material and equipment suppliers, Consulate or embassy, if appropriate and, on a nearby job site, look for customs and practices.

- **Personal Inspection:** walk around the site at two different times of the day for different "points of view." Air recon may be helpful. Don't forget to look *up* as well as down.

- **Photography:** Take photographs liberally. The argument between 35mm slides or Polaroid shots seems best resolved by taking a Polaroid picture of every must detail and taking lots of 35mm or box-camera shots for general use.

- **Sketches:** There is no substitute for a clear sketch, well labelled and dated, made with the assistance of a hand level and steel tape.

- **Samples:** Physically touch and feel the materials on site. Descriptive terms such as "Marl" or "densely compacted" are deadly because of the wide variance in interpretation and practice from one region to the next. Ask to see and feel soil cores taken from the site.

- **Notes:** Almost all data collection will require note-taking. Clip-board and scratch pad notes usually start out neat, but end up illegible. To counter this, use a small hand-held tape recorder and transcribe notes from it each evening.

- **Published data:** Local maps, brochures, and photos can often be had cheaply. The ultimate in useful data, though, is a local phone book. Phone books can be purchased, or "borrowed," if necessary, and will not only tell you how many firms are in a particular business, but how they are organized (LTD, INC., etc.).

The temptation mentioned earlier to negotiate site visits out of A-E contracts is a relative of the temptation to make the site visit as short as possible. Isn't it strange that the more remote and unpleasant a site, the shorter the site visit tends to be, when in fact, these are the very sites where an overlooked problem is the most expensive and causes the most delay?

THE VISIT REPORT

The remaining step is to make site visit information available to those who need it, in a readily useable form. A good goal is to have the visit report written before you arrive home, or back at the office. One advantage to this is data freshness. Another is that the

pressures of the office routine won't pull you away from the report.

How should the report be formatted? Many businesses have standard formats suited to their organization and approach. Almost any well-thought-out format is as good as any other. Barring a standard format, ask future users of the report for their preferences or needs. If no format is suggested, the following is recommended.

- Brief sheet — single 8½ x 11 summary of most significant points and findings. (A courtesy for your boss to give his boss, etc.)
- Outline of what follows.
- Complete narrative report of visit.
- Photos, labelled clearly.
- Maps, brochures, other materials.
- Rough notes (destroy them only *after* the project is finished).

The effective site visit is timely, made by a responsible professional, well prepared-for, thoroughly conducted, and promptly reported. The NAVFAC family, in managing Navy construction, can avoid many delays, hidden costs, quality compromises, claims, and confrontations by insisting on effective, construction-oriented site visits by those with validation authority, in-house designers, A-E Firms, Seabees, ROICCs and Constructors.

The Effective Site Visit: A Checklist

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THE STANDARD SITE CHECKLIST

Use this list only to see if some of these items should be added to the checklist you and your team developed by studying the plans, specs, reports, and other information you obtained. Some items apply to overseas work only.

• **Project data: Name of Project** — official name, identification number, if any (P-007, etc.); **Sponsor** — name, address, phone, officers and representatives' names, address, phone, cable, authority, if a government entity; **Location** — country or state, nearest towns and cities, population, relation to prominent geographical features, elevation above sea level, latitude, if important; **Project Scope** — essential features of project, unusual features, engineers and/or architects involved, plans and specifications — when, where and how obtainable.

• **On the Site: Topography and Geology** — of the region, of the site, general character of local formations, available data on foundation conditions, geological reports, drill logs, soundings, records of sampling and testing, cores and samples, test pits, shafts, drifts, surface indications, soil characteristics, probable difficulty in drilling and shooting, mucking, pile driving, or other foundation work, variation in foundation quantities, ground cover; **Hydrology** — streams and rivers affecting the project, drainage area, available records, length of time kept and probable accuracy and reliability, flood seasons, flood peaks, flood durations, low flows, depths of waterways at important locations, regular changes in level, irregular changes in level, causes, probability of occurrence during construction, possible variation, probable effect on work; **Climate** — temperature minimums and maximums, precipitation seasons and peaks, snow, humidity; tide, direction, strength, range and effect; normal season for the work involved, probability of interference during working season, working space, location of existing structures and utilities, and disposal areas.

• **Contract Data** (for OICC or EFD personnel): proposals to be received and read — pre bid meeting place, time, agenda, public or private; **Form of Proposal** — firm bid, submission of data for negotiations, other form; **Bid guaranty required** — type (Bid Bond, Certified Check, etc.), amount; **Contract bonds required** — type and amount, performance, payment; time limits, penalty and bonus; **Auxiliary bidding data, if required** — bidder's financial data, references, bidder's experience record, plant and equipment available, other evidence of bidder's fitness for the work.

• **Unfavorable natural conditions: Weather** — excessive heat, sudden cold, excessive or deficient precipitation or humidity, mud, frozen ground, fog, storms; **Ground water** — data on water levels, work affected, porosity and probable inflow, stability of saturated soil, swampy ground, quicksand, natural gas, hot or chemical springs, lack of water; **Insects and animal life** — destructive, annoying, disease bearing, disease or unhealthful conditions; **Disasters** — interference or damage from earthquakes, landslides, floods, tornados, tidal waves, typhoons, or fire.

• **Natural Materials:** use, source, quantity, quality, processing required, probable waste, etc. of concrete aggregates, stone, fill and embankment material, water, native timber, sand.

• **Local Markets: Availability, suitability, and cost** — equipment, maintenance and repairs, tools, explosives, fuel and lubricants, lumber and other wood products, structural and reinforcing steel, asphalt and

tar products, cement and admixtures, brick, stone, other items which may be locally available, and names of suppliers.

• **Local facilities: Freight service** — rail, truck, air, steamship, docks and wharves, warehouse and storage yards, sidings and unloading ramps, crane service, light service, switching service, delivery service, nearest airport (elevation, runway length); **Express, mail and passenger service, telephone, telegraph, cable, and radio service, pipe lines; electric power** — where available, capacity, voltage and frequency, reliability, cost; **Highways** — location with respect to project, condition, legal load limits, limitations of bridges, tunnels, or other structures, possibility of bypasses; **Canals & Ports; Living facilities** — for families, single men.

• **Camp considerations: Campsites** — cost of living, housing, rentals, local laws and customs governing camps, availability of fresh water and food, charges for camp service, water, power, and sanitary facilities, entertainment.

• **Labor:** chief source of supply, availability, skill, limitation on selection, availability on office personnel, accountants, fitness for work, productivity expected, union affiliations (present — possible future), jurisdictional problems, work hours, wage scale. (regular, premium — shift work, daily overtime, weekly overtime, Saturday, Sunday, or holiday work, travel time, subsistence) insurance and fringe benefits, workmen's compensation, medical care, unemployment compensation, vacations, severance pay, pensions, bonus, profit sharing, etc., life insurance, probable future changes in wages or benefits, rules or customs regarding hiring and discharging, housing and feeding, safety, payment, settlement of controversies, entry permits, work permits.

• **Laws, Ordinances and Customs:** visas required, liability of contractor for injury or damage to employees, to public, to owner or owner's employees, to employees of other parties on the project, or to the project itself, insurance (required, permitted, or available), taxes on labor, purchases, property, business operation, or income, customs duties, charges, and exemptions, permits and licenses required, currency and exchange rates, limitations on purchases (local preference, etc.), contractor's responsibility for schools or churches, special sanitary regulations, special trespass laws, discrimination against U.S. contractors, if any, practices with regard to guards.

• **Local subcontractors:** names and address, apparent qualification and fitness for work, items covered by subcontract bids.

• **Other work in progress or planned:** present status, scope, and schedule.

• **Miscellaneous:** phonebook, local photographs, maps, pamphlets, taxi costs, local hotels.

• **Environmental Considerations:** laws, requirements or anticipated problems with noise, dust, blasting, hauling, burning, flight operations, drainage, work hours, utility disruptions, economic impact.

REMOTE — Construction in the hinterlands has its own unique problems. These are often compounded when responsible officials decline site visits that could uncover and anticipate problems. Problems — such as inadequate local grades of building materials in remote areas — are more easily solved early.

CECOS To Harvard: A Wealth Of CEC Education Opportunities

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The goal of any training program is to support the mission, purpose and goals of the organization. This is true in civilian as well as military organizations and experience, alone, is a long and tedious enhacement process. Training accelerates and directs the experience process by providing knowledge gained previously through experience and proven by others. Training also allows development of each officer's potential, fulfills natural drives for satisfaction and grants the opportunity for advancement.

Training is a lifelong process and, for CEC officers, it may take the form of professional military or professional engineering training. The "delivery system" may be Navy schools or civilian institutions and the specific training may take a few days or extend to years. It may be directed at junior officers or senior officers.

In short, CEC officer training is varied to meet the needs of the Navy and the desires and capabilities of the individual. This article will pull together all the training programs available to CEC officers and put them in perspective.

CECOS BASIC COURSE

All CEC officers have a common initial training background in that they are engineers or architects. Whether commissioned through NROTC, Naval Academy, OCS or OIS, CEC officers are required to attend the Civil Engineer Corps Officers Basic Qualifications Course. The "Basic" course orients newly-commissioned officers and officers recently transferred to the Civil Engineer Corps in the role of the CEC in the Navy. The course also prepares each officer for his first duty assignment.

The first two weeks of the curriculum are devoted to subject matter common to all CEC billets, and topics include engineering management, financial management, organization of the CEC/NAVFAC community, professional development and human relations.

Students enter separate "tracks" in the third and fourth weeks, depending on their initial duty stations. Topics during these two weeks include civilian personnel management, enlisted personnel administration, Navy Industrial Fund, Shore Facilities Planning and military training.

The remaining four weeks are spent training for the officer's first assignment in public works, contract administration or construction battalions.

ENROUTE TRAINING

As officers are transferred from one job assignment to another, the need for training is critical. With little "career" experience and no job experience in his new assignment, training is needed to help him reach peak effectiveness quickly.

In the past, the CEC met this need through enroute training; i.e., training received between duty stations. There were several restrictions on using this method. First, funding, which came solely from BUPERS, was not sufficient to train all officers. Also, timing of officers to be detached and officers to report was crucial to meet a class convening date. This also lengthened

SCHOOL — Despite diverse backgrounds and educations, all CEC officers have at least one school in common — CECOS. Here, basic students gain the fundamentals they will need for their future roles as construction contract administrators, Seabees, Public Works officers, or staff CEC officers.

the "daisy chain" of actions required in detailing of relieving and detaching officers. Third, class availability limited the number of officers who could be made available for training.

In view of this, NAVFAC included as part of the Command Management Plan, the goal of training all officers being assigned to public works or contracts duty when that tour of duty is one in which the officer has not had prior experience. Funding to achieve this was also provided by NAVFAC and the program is scheduled to begin this year.

Detailers are aware of this goal and advance planning involves careful attention to enroute training potentials. Officers who cannot be trained enroute because of detailing constraints will have the same opportunity as part of non-enroute NAVFAC-sponsored training. Preferably, this non-enroute training will occur just before an officer's detachment or shortly after his arrival at his new duty station.

To emphasize the need for and potential benefits of this training, a "Memorandum for Specialty Training" will be attached to each officer's "flimsy" and the officer concerned will get a copy of the memorandum. Pending a positive reply, NAVFAC will forward accounting data to the command, which can in turn, initiate orders.

CECOS SHORT COURSES

Many billets demand more than a cursory knowledge of a particular subject and, to meet his need, CECOS sponsors short courses. These classes convene at various times throughout the year for about one week and, on occasion, classes are held at other stations. Course offerings include Construction Contract Negotiations, AICUZ familiarization, Energy Management, Environmental Protection, Shore Facilities Planning, etc. Funding is usually provided by the local command.

REFRESHER COURSES

Periodic training for specific duty assignments is necessary and benenficial. However, each officer must also be aware of the broader changes taking place in his own profession and the Navy and two courses have been developed to fill this need.

The first refresher training occurs at the seven-nine year career point. This training is referred to as the LT Refresher Course. It fills the need for technological and managerial updating at the operating level. The curriculum is structured to provide "core" subjects as well as electives. "Core" subjects include Labor-Management Relations, Ocean Engineering, Energy Management, Environmental Protection, RDT&E State of the Art, CEC officer performance evaluation and detailing.

To maximize the benefit derived for the individual, several electives are offered including Shore Facilities Planning, Seabee Operations, Public Works Administration, Economic Analysis and Construction Management. The course convenes annually in September and attendance is by invitation of the Chief of Civil Engineers.

The second refresher training opportunity occurs at the 13-14 year career point. This training is referred to as the LCDR Navy Facilities Systems Management Course. Unlike the "downward and inward" view of the LT Refresher Training, this course takes an "upward and outward" approach. The first class was held in September 1975.

Instruction is divided into two areas. The first deals with the Command Management Plan (CMP) and provides a look at Navy planning, programming and budgeting; and defines the environment within which NAVFAC competes for resources. The command's objectives, philosophy of management and organization are discussed. The second part presents the Navy Facilities Systems (NFS) in which the concepts and structure of the NFS and FASCO are explained and discussed.

During each two-week session there are also Distinguished Visitors' Forums where officers have the opportunity to discuss with a senior CEC officer topics such as the "state of the Navy" and the role the CEC/NAVFAC/Seabee community is playing and will play in the future of the Navy. The course convenes annually in April and attendance is again, by invitation of the Chief of Civil Engineers.

SUBSPECIALTY TRAINING

As the individual broadens his experience in the Civil Engineer Corps, he realizes the technical and managerial needs of the Navy are effectually met through post-graduate level education. These needs are well defined in the Subspecialty System and specific post-baccalaureate education billets are indicated in Part III of the CEC Directory, NAVFAC P-1. Since nearly 25 percent of all CEC subspecialty requirements are at the LT level, it is essential that graduate education, particularly in the technical curricula, be completed early.

Officers are selected for postgraduate school by the annual Navy-wide selection board which convenes in August. The process is set in motion with the publication of OPNAV-NOTE 1520 and the CEC program is spelled out by NAVFACNOTE 1520. This notice outlines available programs, eligibility criteria and provides a preference card. Preference cards are also included at the back of NAVFAC P-1 and should be submitted annually in April.

The selection board has subpanels for each officer designator group (i.e., 11XX, 3100, 5100, etc.) and the CEC subpanel has two senior CEC officers who make all CEC selections. The two basic criteria for selection are academic excellence and professional performance. Generally, greater emphasis is placed on the latter. In the selection process officers are first viewed for their primary choice for selection as a principal or an alternate. Officers who are not selected for their first choice are subsequently viewed for follow-on choices.

On approval of the board results, each CEC selectee receives a selection notification letter which also indicates probable school assignment date. This school assignment date is determined on the basis of officer availability (projected rotation date), selection status (principal or alternate) and quotas available.

Generally, principals are ordered to school at their first rotation after selection. Alternates are ordered to school as quotas become available and, at present,

it appears most alternates will go to school. Principals and alternates selected, but not available to attend school, retain their eligibility and are banked for up to three fiscal years.

Orders are issued four to five months in advance of class convening. Normally, all officers entering civil electrical, mechanical, ocean and petroleum engineering curricula are ordered to school for twelve calendar months. Navy financial management selectees are initially toured for eighteen months, however, this tour may be shortened for officers who have already completed and can validate some prerequisite courses. A firm tour length is established after the first quarter of school.

Graduation is not the end of the continuing Subspecialty System process since use of the graduate officer is necessary to obtain a return on the investment of time and money. The detailers give use and billet

ADVANCED — Other schools for CEC officers range from seminars on AICUZ, to top level management courses at Harvard for the most senior officers.

requirements consideration in making assignments. The goal is to assign an officer his first "utilization" tour within two assignments after completing school, and assign at least two "utilization" tours during a career.

SERVICE COLLEGE

Education during the first ten years of service is concerned with meeting the Navy's technical and managerial needs. The Service College Program's goal is to develop a cadre of naval officers familiar not only with the Navy, but also with international affairs, national policy, tri-service roles and joint command functioning. Attendance at a service college is considered a significant milestone in an officer's professional military development.

The program scope for CEC officers includes (annually) four LCDR students at the Armed Forces Staff College; three at the Naval War College, one LCDR Command and Staff Course and two CDR Naval Warfare Course students; one CDR/CAPT at the Industrial College of the Armed Forces; and one CDR/CAPT triennially to the National War College.

No formal applications are required to attend service college. Annually, the Chief of Civil Engineers nominates to the Chief of Naval Personnel six officers per school quota for screening by the Annual Service College Selection Board. The board convenes annually in October and the CEC subpanel is headed by a senior CEC officer.

Principal selectees are notified by letter and alternates would be notified only if a vacancy occurs.

EXECUTIVE TRAINING

Because of the Navy establishment's complexity, there is a need for management training for senior level executives. The CEC recognizes this and each year picks two officers — one CDR/CAPT and one CAPT/FLAG — to attend one of several civilian schools of business administration. Historically, the CEC has used three schools: Harvard's Program for Management Development and Advanced Management Program, MIT Sloan School of Management, and the University of Pittsburgh Management Program for Executives.

The University of Pittsburgh was used in the fall of 1975 and was well received. Since demand exceeds quotas for the Sloan School, the CEC must compete for seats with other Navy commands. NAVFAC is authorized direct liaison with Harvard and Pittsburgh and is not quota constrained. The courses are intended for executives who are, or are selected to be, in top management positions.

The programs present management tools and concepts, perspectives of organizational problems, and a working knowledge of marketing, production, finance and human relations.

CAPTAIN'S INDOCTRINATION COURSE

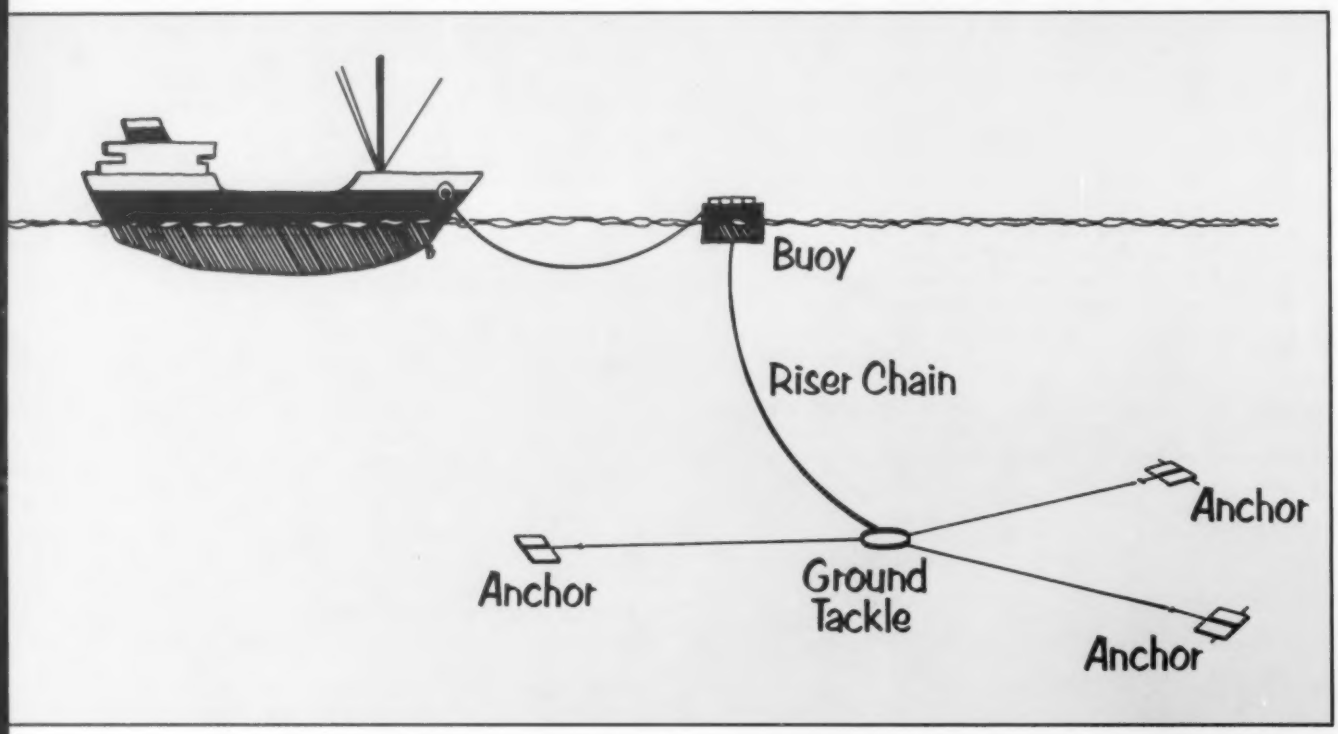
The good reputation enjoyed by the Civil Engineer Corps is due mainly to the stature and prestige of senior CEC officers.

Each year, newly selected captains join this elite group and exert a significant influence on the future of the Corps. To equip these officers to assume this role, NAVFAC/CHCIVENGS sponsors a two-day indoctrination course for newly selected captains. Topics include trends in the Navy, philosophy and policy regarding engineering, construction contracting, management, as well as the status and trends in the CEC and Seabee communities.

Formal education programs, however, are not the only avenues of professional development available to CEC officers. In fact, formal education satisfies only one of the requirements essential in attaining the ultimate mark of professionalism — registration as an architect or engineer. This achievement should be reflected in official personnel records, including copies of registration certificates.

As human and financial resources diminish, personal initiatives in off-duty and non-traditional education programs will play a larger role in upholding the professional reputation of the Corps.

This will be particularly true in postgraduate education programs where financial resources are scarce.



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What are fleet moorings? As used in the Navy, they are off-shore docking devices for securing naval ships when berthing is not available at nearby piers, wharves or when hazardous cargo such as ammunition does not permit berthing at permanent facilities.

The mooring consists of a ground tackle arrangement with necessary fittings on the bottom of an anchorage area and connected by means of a riser chain to a buoy riding on the water surface by which a ship can be made fast to the ground tackle. The responsible agency for designing, budgeting, installing, inspecting, maintaining and repairing fleet moorings Navy-wide is NAVFAC.

Today, there are about 425 moorings in service which must be overhauled regularly to prevent disasters or serious losses. All active moorings are inspected annually and repaired in-service where feasible. The overhaul cycle varies from three to five years depending on location of the particular moorings.

The Navy has standard fleet moorings which range in holding power from 5,000 pounds (2,270 kilograms) for small craft to 30,000 pounds (13,620 kilograms) for large carriers. Mooring buoys range in size from three-foot-six-inch (1.01 meter) spherical buoys to 17-foot (5.2 meter) diameter by ten-foot-six-inch (3.2 meter) high cylindrical buoys. Criteria for fleet moorings is included in NAVFAC Design Manual DM 26. Besides criteria it also includes a listing of equipment which should be kept on hand for proper maintenance.

The size and shape of buoys vary. The Class "A-A" buoys are the largest ones in NAVFAC's inventory and are used mainly for aircraft carriers. Class "D" moorings are used for lighter class ships, such as destroyers.

Average value of a mooring installation can range from $35,000 to $50,000 with some large installations costing over $100,000. The current estimated value of the fleet mooring equipment is more than $27 million. Procurement of new fleet moorings and other mooring hardware such as buoys, winches, anchors, riser chains, joining links, sinkers and ground rings needed for existing fleet mooring maintenance is funded from the Other Procurement Navy (OPN) appropriation. Maintenance and repair as well as installation of moorings is financed from the Operations and Maintenance, Navy (O&M,N) appropriation.

Since considerable lead time is needed to get mooring components, a number of components and fittings are retained ashore at some activities. It is NAVFAC's goal to have several complete medium size mooring assemblies available to meet urgent requirements.

Wherever possible, fleet mooring maintenance is

Keeping Ships Moored Can Be Complicated...And Costly!

accomplished by Public Works personnel. When this maintenance is not feasible, accomplishment is by contract. Disestablishment of Naval Facility Argentia required an immediate decision regarding a permanent East Coast stock point to store serviceable mooring components. Lack of convenient storage area and personnel ceiling constraints at PWC Norfolk indicated that the functions be located elsewhere. Consequently, CBC Gulfport has been designated as the East Coast stock point for all maintenance, overhaul and storage of fleet mooring components.

PWC San Diego will continue to handle the West Coast mooring program. Outside CONUS, the task is accomplished by PWCs Guam, Pearl Harbor and Subic Bay. The European area is covered by Naval Station Rota, Spain, and Naval Activity United Kingdom.

To achieve a longer maintenance cycle, NAVFAC, in conjunction with Civil Engineering Laboratory, has devised a system using cathodic protection for the underwater portion of fleet moorings. This method consists of using aluminum anodes connected to the anchor chains and buoys to provide electrical continuity.

The system consists of sacrificial anodes to provide the necessary electric current, wire ropes for imparting electrical continuity throughout the ground tackle, and fittings necessary for joining components to the mooring and to each other. Anodes increase the life of the buoys and anchor chains to well over 15 years in an aggressive environment area and even longer in a milder location. Without any protection the effective life of a mooring is from five to eight years.

From the economic standpoint, tests over 15 years indicate cathodic protection will reduce scheduled mooring maintenance costs by almost 70 percent, regardless of the mooring class. However, an initial investment for anode installation must be made.

Recent developments include explosive anchors, deep sea moors and fiberglass buoys. The explosive embedment anchor recently used in Diego Garcia derives its holding power from a fluke embedded explosively into the sea floor. Its use was made necessary because of unusual bottom coral conditions.

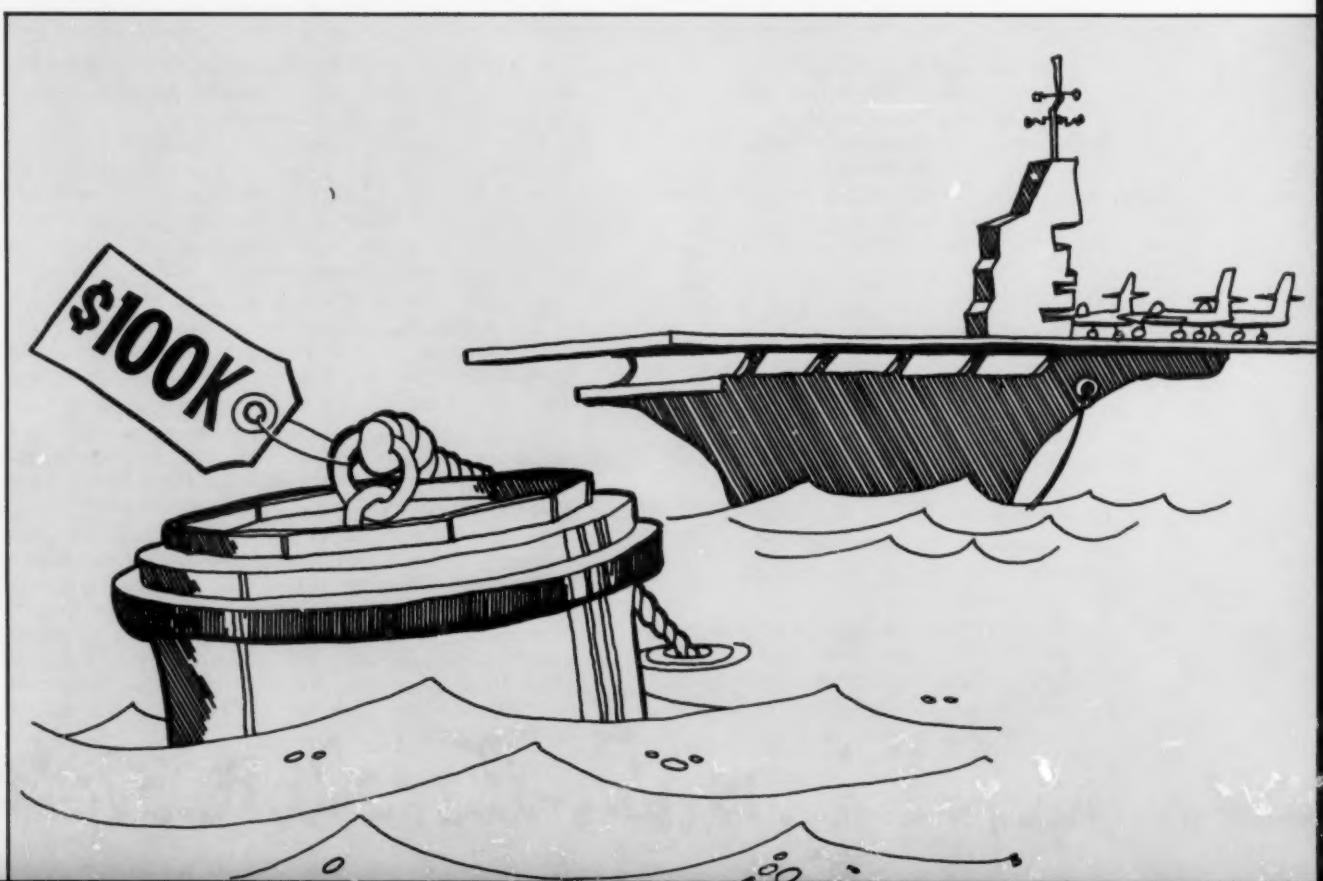
Buoys and their components are subject to abrasion, collision, barnacles and corrosion. Pulling the buoy out of water, cleaning it, repainting it and installing new fenders is expensive, especially when required every three years in certain areas.

NAVFAC, therefore, now coats buoys with fiberglass.

Pacific Division (PACDIV) has used a fiberglass polyester resin coating on the exterior of their steel mooring buoys in a very harsh environment. From all indications, fiberglass coated buoys may be protected for up to 15 years before recoating is needed. However, due to the recent budget cuts, the program has not been fully funded. Nevertheless, NAVFAC plans to coat all fleet buoys as funds and time permit.

Finally, moorings can break loose and inflict damage to the ship, pier or another ship. It is impossible to predict where or when this will occur, but one severe storm at an activity where there is a concentration of moorings, such as Pearl Harbor or San Diego, could result in using up the entire fiscal year fleet mooring budget.

Therefore, NAVFAC must and will continue to budget and fund the fleet mooring program so improvements and maintenance can play an active part in the support of the fleet readiness program.



CONTAINING OIL SPILLS

By REGINALD TUNSTALL
Materials Engineer, CESO •Port Hueneme, Calif.

Oil spills have been a focus of public attention since the Santa Barbara Channel incident of 1969, and the more recent oil tanker spills on both the east and west coasts. With increased offshore oil exploration plus the vast increase in the size and number of oil tankers, the potential for catastrophic spills increases daily.

The Federal Water Pollution Control Act, 1972 Amendments, and the Water Quality Improvement Act of 1970, prohibit discharging oily materials directly on land, into inland waterways, or into the waters of the territorial sea, and contiguous zone.

In spite of preventive efforts, oil spills will occur because of human carelessness or calamities beyond human control. Coastal or in-harbor spillage is critical because of immediate environmental effects. Spills must be contained for two reasons: holding spills near the ship, pier, or shore facility localizes the problem; and containment eases clean-up.

The Navy's environmental protection program spurred system development and personnel training to handle any oil spill problems at harbor and shore facilities.

Containment involves a barrier system, usually a mechanical boom incorporating float devices and a continuous fence or skirt, which extends below and above the water surface. Oil is removed by a "skimmer" which separates water and oil at the surface by passing it through the separator mechanism and storing the oil in a holding tank.

Additionally, for open sea areas, oil can be absorbed into styrofoam or polyurethane plastic chips. Chips are spread over the spill by the thousands and are later collected and "squeezed" to collect oil. The chips are recycled for further use.

Development tests during the past three years at naval harbor facilities on both the east and west coasts have proven the concept and equipment adopted by the US Navy. System efficiency can be judged by tests at Long Beach Shipyard, which resulted in the recovery of 99.6% of the oil spilled.

Using commercially available equipment, the Navy has budgeted $30 million for equipment and personnel training. The goal is to outfit 104 naval activities worldwide to handle oil spills. The program is managed by the Civil Engineer Support Office, NCBC, Port Hueneme.

NAVFAC is responsible for port and harbor facilities and over half have already been equipped to handle any oil spills. Those facilities with the largest fleet concentrations or the most stringent environmental requirements were the first equipped. Program completion is scheduled for 1980.

The Civil Engineer Support Office also manages procurement specifications for the equipment, operating personnel training requirements, instruction at contractors' facilities, preparation of films and manuals, and a continuing program of development to keep the Navy at "state of the art."

ON ADVICE OF COUNSEL

By WILLIAM H. SPECK
Counsel
NAVFAC HQ

"I will not cease from Mental fight,
Nor shall my Sword sleep in my hand,
Till we have built Jerusalem
In England's green and pleasant land."
— William Blake

Rarely have so few words caused so much consternation (and bad jokes) as these from the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4332): *"Congress . . . directs that, to the fullest extent possible . . . all agencies of the Federal Government shall —*

(c) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on —

(i) the environmental impact . . .

(ii) any adverse environmental impact . . .

(iii) alternatives . . .

(iv) The relationship between local short-term uses . . . and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources . . ."

It goes on to require consultation and to direct the report and comments "accompany the proposal through the existing agency review processes."

Note the strong words — "to the fullest extent possible." Note the comprehensive words — "all agencies of the Federal Government" — without exception for Defense. Note the ambiguous words — "major Federal actions significantly affecting the quality of the human environment" — what are these?

Note the burdening words — "a detailed statement by the responsible official" — not by some contractor. And look at the scope of what must be dealt with in the Environmental Impact Statement (EIS).

Further, Council on Environmental Quality Guidelines (40 C.F.R. 1500.11) prescribe at least 90 days (including 30 days after the final text) for circulation, comment and public hearing, after the EIS has been prepared, which may have taken a year or more.

NAVFAC's actions have been challenged in some thirteen suits demanding full, meticulous compliance with NEPA, for environmental and anti-defense establishment groups use the law to attempt to halt projects they dislike. And four suits have brought these groups some success in their efforts to halt work or compel additional environmental treatment. The words of NEPA must be taken to heart early and throughout the planning of Navy projects.

DESERT — Severe, even for its Mojave Desert environment, the Lauritsen Laboratory projects an austere exterior image. Once inside (right) a courtyard, open-air conference space, and rest areas make the lab downright pleasant.

Designing For The Desert

By ELIZABETH BABCOCK
Special Writing Projects Branch

• China Lake, Calif.

The bright, barren expanse of California's Mojave Desert is ideal for Navy research, development, testing, and evaluation of air warfare and missile weapon systems. But the same unrelenting sunshine that allows year-round testing on the ranges of the Naval Weapons Center (NWC) recently became a design problem for architects planning a new research laboratory.

Laser and related optical work, becoming increasingly important for components development for new defense systems, have proliferated in recent years at NWC. Dozens of groups working on related projects needed to be brought under one roof, and the unique requirements of these projects for controlled light and special electrical circuits needed to be considered. The architectural answer to these requirements is the center's new Lauritsen Laboratory, a $3.46-million structure named in honor of Dr. Charles C. Lauritsen, a pioneer in nuclear physics and rocket research.

The building's designers reconciled esthetics and motivational considerations with practical requirements of laser and optical research. The designers needed to meet the light-control requirements for over 90 percent of the experiments conducted in the building; they also had to consider human requirements for light and space normally met by use of windows.

To solve this problem, windows were eliminated from offices and laboratories but the outdoors was brought inside through use of an interior courtyard. From the front, an austere, windowless facade is relieved only by the gentle curve of the entryway. But the shady courtyard enclosed by the building is designed as part of the working environment. A wall of windows along the south side of the courtyard provides an outdoor view for all building occupants and the courtyard's built-in tables and benches allow outdoor meetings.

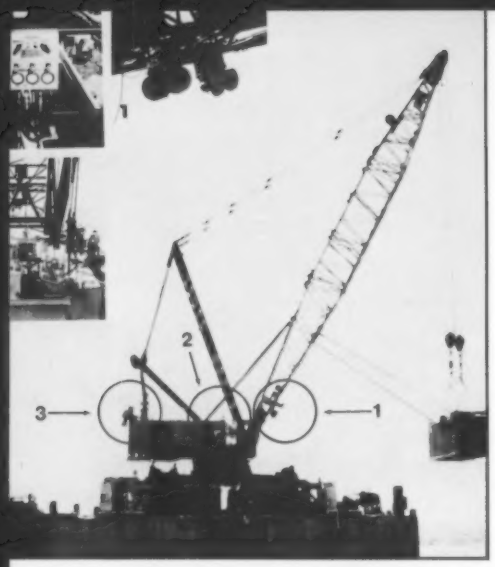
Other unique lab features include a laser tunnel with special wiring for safety interlock controls, a rooftop facility for outdoor tests to the horizon, and provisions for propagating laser energy from inside the building to a 546 yard (500 meter) eye-safe outdoor laser test range.

Two conference rooms have projection facilities and three large receiving bays allow convenient delivery of large equipment. In some laboratory areas, special air-conditioning control has been provided. The optics shop, for instance, can be made much colder and more humid than the rest of the laboratory.

Special wiring in the building allows operation of equipment that must function at sea or in the air. To simulate electrical conditions of ships or aircraft, special circuits have been installed that provide 400-cycle power or, through a DC rectifier, 28-volt direct current. The safety interlock controls in the laser tunnel automatically either shut off the circuit or block the laser beam if someone inadvertently enters the area.

The 18,500 ft^2 (1,720 meter^2) structure was designed by the A & E firm of Gruen Associates of Los Angeles, Henryk J. Walocha, Director of Engineering. Construction was accomplished under contract awarded by WESTDIV to the J. R. Youngsdale Construction Company of San Diego, Dave Johnson, Superintendent.

The construction team at NWC consisted of Dr. Truman G. (Ted) Bergman, Technical Coordinator; George Pomeroy, Project Design Engineer; CAPT William F. Daniel, CEC, USN, ROICC; and LT James A. Roberts, CEC, USN, AROICC.



TAGLINE — The CEL-developed powered tagline can handle loaded standard container pendulation. The system's components, mounted on the Army's P&H 6250 crane, are 1. a winch module, 2. a control module, and 3. a power module.

POWERED TAGLINE EASES CONTAINER TRANSFER TASK

Successful tests at sea of a powered tagline system revealed that dangerous load motions can be controlled and large containers can be transfered effectively.

The Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif., conducted week-long operational tests in November off Fort Story, Va. Held in connection with the Army LOTS (Logistics Over The Shore) pretest Task Force Heavy Hook, the sea trials were an extension of advanced development tests conducted at CEL this summer.

Load pendulation has long been a problem for all floating cranes transferring containers. The unloading rate is adversely affected by load pendulation which also creates hazards to personnel and equipment. One method employed to control pendulation is the manual tagline. But the size and weight of containerized loads are beyond the ability of the crews manning these taglines. The predicament dictated a need for development of pendulation control equipment.

The powered tagline concept was developed by CEL under the sponshorship of the Naval Facilities Engineering Command (NAVFAC). The prototype unit used during the tests was designed and fabricated by Tracor Marine, Port Everglades, Fla., under contract to CEL.

James J. Traffalis, CEL engineer in charge of the powered tagline project, said the advanced development tests conducted at the Laboratory used an 85-ton (77,000 kg) rated crane with a 70-foot (21 meter) boom to transfer 15 containers. In-plane pendulation was reduced by 75% and operator effort to control out-of-plane pendulation was reduced by 50%. Upon completion of tests at CEL, the prototype tagline system was sent to Fort Eustis, Va., for installation on an Army P&H 6250 mobile crane for additional operational testing.

The powered tagline system consists of three modular components: the control module, mounted on the guard rail just outside the crane cab but convenient to the operator; the power module, mounted over the counterweights on the rear of the upper rotating portion of the crane; and the base module, hung from the bottom of the boom, approximately 10 feet (3.05m) up from the boom pin. The two cables from the winch unit were run an additional 30 feet (9.15m) up the boom, then fair leaded to the spreader bar.

The P&H crane, mounted on a 60 x 150 foot (18 meter x 46 meter) DeLong barge, was used to load and unload 20-foot (6.1 meter) containers ranging in weight from 10 to 20 tons (9,100 Kg-18,200 Kg) during Task Force Heavy Hook. The 250-ton (227,000 Kg) capacity crane was equipped with a 100-foot (30.5m) long heavy-duty tipped boom with dual hooks.

The prototype system was deployed constantly during the week-long container-handling operations. The system performed well, steadying loads during transfer in 25 knot winds. It also proved invaluable in positioning containers over a lighter deck, a task extremely difficult (if not impossible at times) for the deck crew to accomplish with manual taglines. Pendulation was never a serious problem during these particular tests because the natural period of the pendulating load was detuned from the roll period of the barge. However, load pendulation is still a serious problem when the roll period of the platform is about the same as the natural period of the pendulating load.

The operation of the system did not interfere with the crane operator while he was operating his equipment. The tests also showed that the taglines did not interfere with hold (cell) or truck operations.

The prototype system is completely self-contained, consisting of a base module with wire storage, power module and control module. The system is capable of developing and maintaining tensions up to 1,000 pounds (455 Kg) on each line. No-load line speeds of 50 to 60 feet (15-18m) per minute are possible.

The base module contains two hydraulic winches and their fairleads mounted on a common base. Each winch can store 200 feet (60.1m) of 5/16-inch (8mm) diameter wire rope.

The power module contains an 18hp diesel engine, fuel tank, hydraulic pump, hydraulic valves, and hydraulic oil reservoir.

The control module contains the remote controls for starting and stopping the diesel engine and for setting and releasing the winch tensions. The control module can be mounted up to 75 feet (23m) from the base module.

The CEL prototype unit will remain with the P&H 6250 crane for additional operations in the Fort Story area.

A FAREWELL FROM TOPSIDE

". . . I've had a lot of fun and hope you have, too!"

Rear Admiral Marschall Retires June 1, 1977, As Commander, Naval Facialities Engineering Command And Chief of Civil Engineers.

By REAR ADMIRAL A. R. MARSCHALL, CEC, USN

For the past four years I have had the privilege and opportunity both to guide and view the Naval Facilities Engineering Command from a unique perspective. The period during which I have served as Commander, Naval Facilities Engineering Command, and Chief of Civil Engineers — May 1973 through May 1977 — has been unusual in many ways. This particular time frame was beset by double digit inflation, a national energy crisis and the worst recession in the U.S. construction industry since World War II. We have been confronted by challenges on many fronts . . . energy conservation, pollution abatement, environmental protection, the requirement to provide increasing facilities engineering services with significantly diminished resources, and the post-Vietnam phase down.

Despite our problems and constraints, the Naval Facilities Engineering Command has successfully risen to the challenges of the mid-1970s and has provided outstanding facilities engineering support to the operating elements of the Navy.

Among the most significant accomplishments of the past four years has been our ability to turn around the progressive erosion of our Military Construction Program purchasing power by expediting design and construction awards in order to get more construction underway during each fiscal year. This speeding up process has yielded considerable savings in the race against inflation. Against a historical figure of award levels of less than 40% per fiscal year, we have achieved awards of 70% of our MCON program during FY75, and 80% in FY76.

The most significant single project undertaken by the Naval Facilities Engineering Command during my tour as Chief is our TRIDENT System Facilities Program. We have currently let some 275 million dollars worth of construction for the TRIDENT Support Site, NAVSUBASE, Bangor. Work in place is averaging $12 million per month. This facility, which is targeted for completion in time to support initial operational capability of the TRIDENT System in 1979, will provide integrated and dedicated refit and logistic support to the TRIDENT advanced technology fleet ballistic missile system.

In addition to the TRIDENT Support Site in Bangor, the TRIDENT System requires facilities for missile flight tests at Cape Canaveral, Florida; follow-on missile testing at Point Mugu, California; and relocation of existing conventional facilities from NAVSUBASE Bangor to the Indian Island Annex of Naval Torpedo Station, Keyport, Washington.

We are currently in the planning stage of another TRIDENT related facility . . . an east coast Fleet Ballistic Missile Submarine refit site which may be located in Kings Bay, Georgia. Final site selection has not been made but Kings Bay is the preferred alternative site at this time. The complex, when constructed, will provide a base for refit of the new TRIDENT I missile into existing Poseidon submarines and it will accommodate the Rota, Spain FBM squadron which must be relocated by July 1, 1979 in accordance with the Treaty of Friendship and Cooperation with Spain.

Another of the major projects of the Naval Facilities Engineering Command now underway involves the 265 million dollar program which provides for the concurrent modernization of the National Naval Medical Center and the construction of the Uniformed Services University of the Health Sciences in Bethesda, Maryland. The complex project will, upon completion, upgrade the National Naval Medical Center Hospital by expanding its capabilities to provide the latest health care services and techniques; provide maximum use of existing structures; develop facilities for the new Uniformed Services University of the Health Sciences; and

Symbolically RADM Marschall's personal flag is lowered following his final official visit at the Naval School, Civil Engineer Corps Officers (CECOS) at Port Hueneme, Calif.

minimize adverse impacts upon the environment and the surrounding communities. The concurrent construction program for the multi-year modernization of the National Naval Medical Center and the development of the Uniformed Services University of the Health Sciences was initiated in the FY75 Military Construction Program. The 61.8 million dollar contract for the addition to and upgrading of the hospital, the largest single lump sum competitively bid construction contract ever awarded by the Naval Facilities Engineering Command, was signed in June 1976. Construction of the hospital should be completed by December 1979. A total of 80 million dollars has already been appropriated for the Uniformed Services University of the Health Sciences which will provide medical training for uniformed health care professionals. At this writing the fate of the USUHS is in the hands of the Administration and Congress. Only time will tell whether the facilities will be used by the University or for another purpose.

Even before the national energy crisis in 1973 the Naval Facilities Engineering Command was thoroughly involved in energy conservation. This crisis added impetus to our ongoing energy conservation program for the Naval Shore Establishment. As a result of our Energy Conservation Survey Program, NAVFAC engineer teams were able to assist the Navy's shore activities in meeting the Navy's 15% energy conservation goal. This cutback in energy dollars has saved the Navy approximately 150 million dollars since FY74. Our Energy Conservation Investment Program, which identified approximately $170 million of facilities retrofit energy conservation projects with an economic payback of less than six years, should result in an energy cost avoidance of over $100 million by 1985.

In the area of pollution abatement, the Naval Facilities Engineering Command has maintained a high level of effort, approximately $90 million annually, devoted to the elimination of all types of discharges which adversely affect the environment. Over the past four years we have expanded our pollution abatement program to include hazardous waste, solid waste, resource recovery, pest management, ordnance waste and noise pollution. We have also made considerable strides in our harbor oil spill recovery program and reduced our harbor spill problem from a crisis management situation to a routine function Navy-wide.

Another important area in which NAVFAC has taken the lead is the Air Installations Compatible Use Zones Programs. In 1973 the Command was given responsibility for developing criteria, parameters and strategies for defining and resolving the problems of civilian encroachment at Navy and Marine Corps Air Installations. To meet this goal we developed a three-pronged assault: developing the criteria; identifying the priorities and criticality of encroachment on an installation-by-installation basis; and promoting a centralized expertise to inform communities of the problems and the alternatives the Navy/community could use to resolve the problems. We have currently completed 23 individual activity studies and 33 more are underway.

We have made strides in our efforts to improve the Navy's motor vehicle fleet and should see the results of our endeavors over the next few years. About the time of the Vietnam wind-down, the condition of Navy's motor vehicle and mobile equipment fleets had reached an all-time low. In order to halt this deterioration, we have formulated a corrective plan to reduce the age of the Navy's vehicle fleet and enhance fleet mission capability. Through these actions, vehicle and mobile equipment procurement funding has increased from $35.4 million in FY75 to 63.5 million in FY77 and we should soon be on the way to recovery in this segment of our business.

Another area that had been heavily impacted by aging and accelerated deterioration was the Navy's family housing inventory. Because degradation of family living conditions is a major factor affecting morale of Navy members, we were able to obtain a 76% increase in funding for the operation and routine maintenance of Navy family quarters and a tenfold increase from 5 to 50 million dollars in funding for specific repairs. We also developed a Family Housing Maintenance Inspection and Repair Program to ensure that timely and effective actions were taken to maintain Navy housing assets in the best possible condition.

We have made a great deal of progress in our Mobile Utilities Support Equipment Program over the past few years. As a result of this modular self-contained utility service, we now have the capability to provide ships with electrical and steam services on an interim basis at 85% of the Navy's piers while 81 million dollars worth of permanent facilities are progressing according to fleet requirements. Although added resources are needed we

RADM Marschall visiting construction sites.

have improved our posture substantially.

One of the most significant innovations that we made to the Seabee Program over the past few years is the creation of the "Mirror Image" concept for Seabee technical training at Gulfport and Port Hueneme. This action has increased morale of fleet Seabees, improved the quality of training and reduced costs to the Fleets. And in order to fill a void in the training program for Senior Petty Officers in the Seabee community we have implemented a management course for E-6/E-7 personnel at CECOS to develop key middle management personnel in the Seabee community.

We have also made improvements in the Reserve Naval Construction Force in recent years. Permanent Drill Sites, complete with a Readiness Support Allowance for equipment for mobilization training, now exist for all 17 Reserve Battalions. Another innovation, the new Naval Reserve Facilities Engineering Program, provides a resource of mobilization potential for the entire spectrum of Naval Facilities Engineering Command operations.

It has been most rewarding to observe the full integration of our Active and Reserve forces into a truly CEC/Seabee Total Force. I yield to no one when comparisons and analyses are made on Reserve components — our CEC/Seabee Reserve always stands out as the best no matter how you slice it. This is a fine testimonial to the great leadership, past and current, in our Reserve Programs and is also indicative of the high quality Seabees we have in the ranks.

We have developed our underwater construction capability to fulfill expanding Navy requirements. A Fleet Seabee Force of Underwater Construction Teams and a NAVFAC technical support organization were established to enhance the Navy's capability to plan, design, construct, and repair underwater facilities. We have also acquired a 20 million dollar inventory of specialized ocean construction equipment . . . most notably the dynamically positioned platform "SEACON" which was specifically designed to perform deep ocean construction projects such as the recovery and replacement of large acoustic tracking arrays.

In the Research and Development area we are in the final developmental stages of the Container Offloading Transfer System, a method of providing a compatible logistic support system for container ships employed in support of contingency operations. We have also made progress in the complex fields of Automatic Data Processing and telecommunications technology over the past few years based on the nation-wide, functionally oriented Naval Facilities System.

We have maintained a high standard of professionalism in our Civil Engineer Corps ranks and have made strides in improving professional registration levels for both architects and engineers.

On the civilian side of the house we have implemented the NAVFAC Civilian Career Plan, a Career Development Plan for Maintenance Personnel, the Upward Mobility Program and a most successful Professional Development Center (PDC) program.

We have made considerable progress over these past four years and a couple of important breakthroughs. This is a testament to the competence, professionalism and ingenuity of the fine staff of the Command and the Corps. Although there remains much to be done, I feel genuinely proud to have had the privilege of serving at the helm of this truly outstanding organization during this period. I've had a lot of fun and I hope you have, too!

A. R. Marschall

A. R. MARSCHALL
Rear Admiral, CEC, USN
Chief of Civil Engineers
Commander
Naval Facilities
Engineering Command

A FLAG POSTSCRIPT — Rear Admiral Marschall will be succeeded by his deputy, Rear Admiral Donald G. Iselin (below, top left). Rear Admiral John R. Fisher (below top right) will retire May 1, 1977, from his dual post as Commander of the Pacific Division, NAVFAC, and Commander, Construction Battalions Pacific, and will be succeeded by Rear Admiral Neal W. Clements (bottom left). Selected as rear admiral, is Captain William M. Zobel (bottom right) whose post has not been announced.

Dismantling McMurdo's Reactor

by LCDR J. L. RENZETTI,
CEC, USN *P.E., Va.*

• McMurdo Sound

Drastic changes have taken place at the PM-3A Nuclear Power Plant, McMurdo, Antarctica. It was shut down in September 1972 and a decision was made to dismantle the plant after discovery of a potential reactor piping corrosion problem. The only structure remaining on the PM-3A site is the Secondary Building which once housed the turbine-generator, auxiliary machinery, "Alice's Restaurant" and the front office.

The scene on Observation Hill represents a three year effort to remove all radioactive plant components in compliance with the Antarctic Treaty which unequivocally prohibits disposal of radioactive waste in Antarctica.

Planning for dismantling began in March 1973. A basic plan called for the project to be completed over a three year period. Detailed planning would be done in CONUS from March through September of each year and site work would be done during the Deep Freeze summer support season of October through February. An outline of the work and schedule included:

• **Deep Freeze 74:** Remove all non-essential primary and secondary systems; ship all materials and equipment to the site; prepare the reactor pressure vessel for shipment.

• **Deep Freeze 75:** Complete the reactor pressure vessel shipping container; dismantle primary buildings; remove reactor containment tanks.

• **Deep Freeze 76:** Final site cleanup.

The major problem dismantling a nuclear power plant is handling highly radioactive plant components, including the reactor pressure vessel. Remote cutting tools, complex equipment and heavily shielded shipping containers are needed. The process is hazardous, costly, and time consuming. The limited operating season, harsh climate and logistics problems of Antarctica further complicate the task.

Detailed plans covering all aspects of the project were developed. The final planning document had over 2,000 pages of detailed procedures supported by over 225 engineering drawings. Men, materials, and equipment were brought in on the normal Deep Freeze resupply system. Small tools and items required early in the season were flown in while heavy equipment and bulk materials were transported by ship which arrived at McMurdo in mid-January each year.

One of the most difficult and challenging problems encountered during planning was design of the reactor pressure vessel shipping container. The 3.5 ft. (1.1 meter) diameter by 8 ft. (2.4 meter) high reactor pressure vessel was installed at the bottom of an 8 ft. (2.4 meter) diameter by 30 ft. (9.1 meter) high steel containment tank.

It was determined the safest, most economical means of removing the reactor was to install depleted uranium shielding around the vessel to reduce radiation, encase the vessel in reinforced concrete and use the steel tank as a shipping container.

After 10 years of operation, the pressure vessel was highly radioactive and dose rates of 3,000 Rem/hr had been measured. Dose rates within the reactor pressure vessel even after the nuclear fuel had been removed were estimated to be 10,000 Rem/hr. Required shield thickness was calculated using standard computer codes.

To speed handling and installation, the shield was made in seven interlocking sections. Each section was 6 ft. (1.8 meter) high by 2 ft.

(.6 meters) wide by 1¾ inch (4.4 cm) thick and weighed 1,500 lbs. (681 kg). Total weight was also an important design factor as weight handling capability at McMurdo was limited to 112,000 lbs (50,800 kg). The fact that calculated values could not be verified by on-site measurements was a continuing concern as once the concrete was placed, any errors found would be very difficult, if not impossible, to correct.

After design was completed, a safety analysis was needed to demonstrate the package met Nuclear Regulatory Commission (NRC), Department of Transportation (DOT) and International Atomic Energy Agency (IAEA) requirements for the transport of high-level radioactive waste. Specifically, the analysis had to show the 50-ton (45,400 kg) shipping container could survive sequentially a 30 ft. (9 meter) drop onto a unyielding surface, a 40 inch (102 cm) drop onto a 6 inch (15 nm) diameter steel bar and a 1,475°F (800°C) fire for 30 minutes. These and other safety requirements were discussed in a 380 page safety analysis report which was approved by the NRC.

The first phase began in early October, 1973, when two officers and 25 men arrived on site. In addition to removing plant components, several unique underwater cutting operations were performed. The first of these involved removal of nine stainless steel clips and other components from the side of the reactor pressure vessel to allow installation of the depleted uranium shielding.

These items were ½ inch (1.3 cm) thick, were highly radioactive and had to be removed from under 4 to 8 ft. (1.2 to 2.4 meters) of water. The The water provided adequate radiation shielding to allow the men to use the reactor pressure vessel head as a work platform. Although the plasma torch used for cutting clips generated considerable turbulence, the water remained clear.

A magnesium-aluminum burn bar was used to cut a hole in the bottom of the reactor pressure vessel. This allowed placement of lead shot for shielding in an inaccessible 40 inch (102 cm) diameter by 17 inch (43 cm) high void space beneath the vessel. Five burn bar elements were bundled together and attached to the end of a 10 ft. (3.05 meter) length of ½ inch 1.3 cm) pipe. The flame from this device was so hot even under 10 ft. (3.05 meters) of water that it melted its way through the 2-3/16 inch (5.6 cm) thick stainless steel in less than 60 seconds.

Pouring concrete around the reactor pressure vessel also proved somewhat tedious. For structural integrity and shielding, it was essential the concrete be high quality and free of voids. The concrete could have been poured underwater but the probability of getting the required quality would have been significantly reduced. Consequently, the concrete had to be poured with all the shield water removed. With a resulting 3000 Rem/hr radiation field in the vicinity of the reactor pressure vessel, the concrete had to be poured and consolidated from the top of the containment tank.

A 30 ft. (9.1 meter) length of 12 inch (30.5 cm) diameter aluminum pipe was used as a concrete chute. The concrete was mixed in batches using a standard 16S mixer. The job required 15 cubic yards (11.5 cubic meters) of concrete with a minimum 28 day compressive strength of 5,000 psi. Consolidation in place was accomplished using standard vibrators with a 30 ft. (9.1 meter) extension.

Reinforcing steel consisted of a double curtain of No. 9 bars at 6 inches (15.2 cm) on centers. Considerable difficulty was encountered pouring and consolidating concrete in the 2 to 4 inch 5.1 to 10.2 cm) space between the tank wall, reinforcing steel and pressure vessel. When the tank was removed, measured radiation levels were well below calculated values which indicated that the depleted uranium shielding had been

(Continued on page 45)

Command Management Plan—'60s Dreams, '70s Realities

By W. R. GRUPE
Deputy Director
Programs Division
NAVFAC HQ

• Alexandria, Va.

It all started with the "Precepts of the Bureau of Yards and Docks" in October, 1963. It was then, after the Secretary of the Navy approved the "Review of Management of the Department of the Navy" and after considerable evaluation of the BuDocks management process, that the Chief of BuDocks, RADM Peter Corradi directed the implementation of Management by Programs.

In the Preface of the "Precepts" RADM Corradi stated, "I intend that management by programs will:

- Clearly identify and define tasks to be accomplished and relate those tasks to Bureau programs and Bureau mission.
- Assist in the determination and allocation of Bureau manpower and dollar resources.
- Assign the responsibility for execution of programs.
- Provide appropriate information on programs in order to inform higher authority of status and utilization of resources.
- Provide a basis for systematized determination of program progress and effectiveness.
- Highlight variations from established plans or goals to permit management by exception in problem areas requiring action.
- Appraise program and managerial performance on a continuous basis."

Today, NAVFAC Command is on the threshold of realizing that vision. To the casual observer, the obvious question is, "Why did it take so long?"

To those involved when this revolutionary concept of management as introduced in the early 60s; and to those involved during implementation of this concept, the delay is not surprising.

What is surprising is the dramatic contrast between NAVFAC management in 1976 and BuDocks management in 1963.

Between 1964 and 1971, thousands of manhours were devoted to a task-oriented Integrated Program Management System (IPMS) within the Engineering Field Divisions.

Not until 1971 when the processing of IPMS was centralized in FACSO was the system ready to serve as a useful management tool. Meanwhile, other systems, such as the CBC Management Oriented Budget Information System (MOBIS), were being developed to relate the resources of other NAVFAC activities to NAVFAC tasks.

These tasks are defined in terms of the products and services NAVFAC provides to customers and the internal support which is required. Management information systems such as IPMS for Headquarters and the EFDs, and MOBIS for the CBCs, are oriented to those tasks and provide a basis for allocation of NAVFAC manpower and dollar resources.

Another area of dramatic change since 1963 has been in the determination of Command goals and the assignment of responsibilities for the execution of those goals.

The first Operating Plan, issued only to the EFDs for FY1967, did define the goals and targets for that fiscal year. However, as the plans for the succeeding fiscal years attempted to incorporate resource considerations, goals were given less and less attention.

Late in 1970, a major revitalization of Command management resulted in a new structure of objectives and goals and in the first Command Management Plan (CMP), which brought together the Precepts, a new Objectives Plan and the annual Operating Plan. This FY1972 CMP for the first time, provided a management plan which addressed all NAVFAC tasks, activities and resources.

Today, after five more years of effort, NAVFAC has realized an achievements-orientation in the management process. Performance goals are used to define quantities of products to be produced, quality and timeliness of products, services and support and various other performance indicators which alert managers to existing or potential problems and provide a basis for communicating these problems to higher authority. Improvement goals highlight significant steps planned to improve the manner in which we carry out our mission. These goals relate to the tasks that are performed and therefore, to the resources used.

The responsibility for accomplishing these goals is assigned to NAVFAC activities by the CMP. Effort will be devoted during FY78 CMP development, to insure goals are specific, measurable, meaningful and provide the manager with data needed to manage effectively.

A systematized basis for measuring progress was realized during FY1976 with the implementation of the Goal Progress Reporting System (GPRS). GPRS reports provide visibility to variations from established goals, highlighting problem areas. They also permit continuous appraisal of program performance and lend greater substance and credibility to both internal resource allocation and external resource justification.

Despite the changes since 1963, the process is not perfect. The potential for effective management is there, but cannot be realized without "fine-tuning."

When all NAVFAC personnel view themselves as part of the management process and are influenced in their day-to-day business by the CMP, then the full potential of the NAVFAC management process can be realized.

Metrication: It's Time For Us To Put Our Best .3048m Forward

BY F. E. HEIN
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• Alexandria, Va.

Passage of the metric act, PL94-168, in 1975 and signing of DoD Directive 4120.18 by Deputy Secretary of Defense, William P. Clements Dec. 10, 1976, underscores the fact that the U.S. cannot retain the inch-pound system. We are now in the same league as Yemen, Liberia, Brunei and Burma.

Changes in the near future which will affect us all are: all speed signs will be metric by Sept. 30, 1978; all wine sold in the U.S. must be bottled solely in metric-sized containers by Jan. 1, 1979; similar regulations apply for all distilled spirits by 1980; U.S. exporters to the nine Common Market countries must indicate dimensions in metric units by 1978.

Seven-Up, Pepsi Cola and Coca Cola are test marketing metric-sized bottles; most large industrial firms are converting to the metric system, including General Motors, Ford, Chrysler, Caterpillar, International Harvester, Honeywell, IBM, 3M, Xerox, Allis-Chalmers, Dow Corning, Exxon, General Tire, Hewlett-Packard, Montgomery Ward, Otis, Sears Roebuck, etc.; weather will be given in Fahrenheit and Celsius; and U.S. Steel is offering tin mill products in either metric or English units.

Conversion will have a significant impact on the Department of Defense. Current DoD policy is to keep pace with industry even if it appears that in certain fields industry is not acting as fast as it should. This way we will be able to accept conversion with minimum cost and disruption.

As a rule, existing designs should not be redimensioned or converted. Such a soft conversion (straight numerical metric equivalents to customary inch-pound design dimensions) would not justify the expense involved. Dual dimensions (i.e., both metric and U.S. customary dimensions) on drawings shall be avoided.

However, tables on a document to translate dimensions from one system to another are acceptable. The metric system will be considered for all new designs. Because of the comparatively long lead time for military weapon systems, equipment now designed in customary units could be obsolete by the time of production. Generally, the construction industry does not need a long lead time and has some flexibility. Materials or equipment to be used jointly with NATO and other allied nations or which have potential for significant foreign sales should be designed and procured in the metric system.

It will be many years before all industries have converted. During this phase, hybrid metric and U.S. customary designs will be necessary and acceptable. The Naval Sea Systems Command is considering design of the first metric ship. The ship will probably be hybrid with the basic parameters metric and the components and parts available in the market whether they are in inch, hybrid or metric. Ships will probably be hybrid for at least another generation until metric-designed pumps, compressors, engines, and other components are available.

The same may be true for facilities construction. A major effort will be made to update existing specifications, standards, criteria and other technical data. Since most publications are

28 grams of prevention is worth 454 grams of cure!

It was a significant 1.6093 km-stone in the history of flight!

reviewed periodically, it should be possible to keep pace with industry timetables. This method will also keep the cost of conversion down.

Costs for metric conversion should be borne where they fall. That encourages people to spend less and rationalize more. The main point is not what it costs but what it would cost not to change to metric. DoD requires all technical reports, studies, and position papers to include metric units in addition to, or in lieu of, English units.

A national metrication program will involve fundamental change and there is a need to plan and manage the change. There will be differences of opinion. We have to address conversion's advantages and problems and resolve problems with the least cost to all involved. Metric conversion will allow many industries to "put their house in order" and get rid of a cumbersome measurement and calculation system. Metrics reduce teaching time and let us use electronic reordering of inventories. For example, conversion to metrics will reduce the number of domestic bottle sizes from sixteen to seven; and for distilled spirits, from 30 to six.

A survey showed over 500 different types and sizes of containers are used for commodities. Establishing

METRIC STYLE GUIDE

In most cases, familiarity with the following metric units will be sufficient for everyday transactions:

	Name	Symbol	Approximate Size
length	meter	m	39½ inches
	kilometer	km	0.6 mile
	centimeter	cm	width of a paper clip
	millimeter	mm	thickness of paper clip
area	hectare	ha	2½ acres
weight	gram	g	weight of a paper clip
	kilogram	kg	2.2 pounds
	metric ton	t	long ton (2240 pounds)
volume	liter	L	one quart and 2 ounces
	milliliter	mL	1/5 teaspoon
pressure	kilopascal	kPa	atmospheric pressure is about 100 kPa

Units of **time** and **electricity** will not change.

The Celsius **temperature** scale should be used, familiar points on which are:

	°C	°F
Freezing point of water	0	32
Boiling point of water	100	212
Normal body temperature	37	98.6
Comfortable room temperature	20–25	68–77

Prefixes

Some of the metric units listed above include prefixes such as kilo, centi, and milli. Prefixes, added to a unit name, create larger or smaller units by factors that are powers of 10. For example, add the prefix kilo, which means a thousand, to the unit gram, to indicate 1000 grams; thus 1000 grams become 1 kilogram. The more common prefixes are shown in Table 1.

Conversions

Conversions should follow a rule of reason: don't include figures that imply more accuracy than justified by the original data. For example, 36 inches would be converted to 91 centimeters, not 91.44 centimeters (36 inches × 2.54 centimeters per inch = 91.44 centimeters), and 40.1 inches would convert to 101.9 centimeters, not 101.854. Table 2 lists many of the more commonly used conversion factors.

Spelling

All units and prefixes should be spelled as shown in this guide.

Capitals

Units: The *names* of all units start with a lower case letter except, of course, at the beginning of the sentence. There is one exception: in "degree Celsius" the unit "degree" is lower case but the modifier "Celsius" is capitalized.

Symbols: Unit symbols are written in lower case letters except for liter and those units derived from the name of a person (m for meter but W for watt, Pa for pascal, etc.).

Prefixes: Symbols of prefixes that mean a million or more are capitalized and those less than a million are lower case (M for mega, k for kilo).

Plurals

Units: Names of units are made plural only when the numerical value that precedes them is more than 1. For example, 0.25 liter or ¼ liter but 250 milliliters. Zero degrees Celsius is an exception to this rule.

Symbols: Symbols for units are never pluralized (250 mm = 250 millimeters).

Spacing

A space is left between the number and the symbol to which it refers. For example 7 m, 31.4 kg.

In names or symbols for units having prefixes, no space is left between letters making up the symbol or name. Examples: milligram, mg; kilometer, km.

a system of six or eight standard containers would save millions of dollars in container and marketing costs. Estimating, quantity surveying and general construction would benefit from simplified arithmetic and unit coherency in the metric system. Also the successes and failures of the British, Australian and Canadian metrication programs should be studied and considered.

Eventually, the entire country will use the metric system and any design now in customary units will be obsolete and difficult to use in the future.

Needed for the construction industry is an "M-Day," or a target date for conversion. We seem to be drifting toward a situation where producers will not make metric products unless they are guaranteed a market. Designers cannot guarantee a market; they can only forecast demand. But an "M-Day" would put the demand on both parties. The Australian approach required every project to be constructed after "M-Day" be in metric units. This gave the producer assurance his metric products would sell.

We in NAVFAC have to be prepared for "M-Day." Our future efforts must be directed to metric training in the preparation of plans, specifications, criteria, definitives, etc.

Period

DO NOT use a period with metric unit names and symbols except at the end of a sentence.

Decimal Point

The dot or period is used as the decimal point within numbers. In numbers less than one, zero should be written before the decimal point. Examples: 7.038 g; 0.038 g.

For More Detail

Approximate conversions for many units are given in Table 2. Some writers will require detailed information on units peculiar to their fields. For example, the British Thermal Unit, calorie, and therm are replaced by the metric unit, joule. Further information is available in "NBS Guidelines for Use of the Metric System," LC1056, free, from the Metric Information Office, National Bureau of Standards, Washington, D.C. 20234, 301/921–2658. Also useful is the "NBS Metric Kit," (SP410), complete with references, charts, a conversion card, and the history of the metric system, available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402; price: $2.

Table 1

COMMON PREFIXES FOR METRIC UNITS

Factor		Prefix	Symbol
1 000 000	10^6	mega	M
1000	10^3	kilo	k
1/100	10^{-2}	centi	c
1/1000	10^{-3}	milli	m
1/1 000 000	10^{-6}	micro	μ

Table 2

METRIC CONVERSION FACTORS (Approximate)

Symbol	When You Know Number of	Multiply By	To Find Number of	Symbol
		LENGTH		
in	inches	2.54	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		WEIGHT (mass)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 pounds)	0.9	metric tons	t
		VOLUME		
tsp	teaspoons	5	milliliters	mL
Tbsp	tablespoons	15	milliliters	mL
in^3	cubic inches	16	milliliters	mL
fl oz	fluid ounces	30	milliliters	mL
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		PRESSURE		
inHg	inches of mercury	3.4	kilopascals	kPa
psi	pounds per square inch	6.9	kilopascals	kPa
		TEMPERATURE (exact)		
°F	degrees Fahrenheit	5/9 (after subtracting 32)	degrees Celsius	°C

'Incrementation' Is Becoming The Latest 'Dirty Word'

by CDR WARREN BELL, CEC, USN
P.E., Penn.

• Alexandria, Va.

Incrementation will be frequently discussed among facilities engineers in the near future. Congressional committees which deal with military construction appropriations have taken an avid interest in this subject. These committees believe the Armed Forces are abusing the minor construction authorities granted by 10 United States Code 2674 by practicing incrementation. The investigative staffs of the Congress can be expected to examine this matter thoroughly either to verify or refute this belief.

This article will clarify policies and regulations dealing with incrementation to allow the CEC-NAVFAC community to address the subject from an enlightened position.

INCREMENTATION IS A 'DIRTY WORD'

Incrementation may not be a four-letter word but it is dirty nevertheless. Navy directives say it is, DoD directives from which they are derived say it is, and Congress says so too! If any doubt existed on that score, it should be dispelled by the following from a report of the House Committee on Appropriations on the FY77 Military Construction Bill (H.R. No. 94-1222).

> *". . . investigators revealed several instances of incremental construction through the use of minor construction. This violates the law and the Directives of Congress. Therefore, it is hereby restated that incremental construction with minor construction funds is prohibited. Necessary management reviews should be established to ensure that no further instances of incrementation are undertaken."*

INCREMENTATION DEFINED

Incrementation is widely recognized as wrong, but there is no definition of it in literature on Urgent Minor Construction (UMC). The definition inferred from correlating references to it in the laws and directives is as follows:

> *Incrementation: subdividing construction which law or regulation requires to be considered as a single project into two or more smaller projects; an intention to circumvent minor construction cost limitations is presumed.*

This is the only sense in which incrementation should be used when discussing facilities projects. Using the word to describe legitimate multiple projects derived from a single basic requirement casts an undeserved cloud over them and unnecessarily impedes their progress toward approval.

INCREMENTATION DISTURBS CONGRESS

The law which establishes continuing authorization for Urgent Minor Construction states:

> *". . . this section does not authorize a project costing more than $400,000. A project costing more than $200,000 must be approved in advance by the Secretary of Defense, and a project costing more than $75,000 must be approved in advance by the (Service) Secretary concerned."*

UMC cost limitations are a matter of law rather than administrative regulation. The clear intent of Congress is that all construction projects costing more than $400,000 receive congressional scrutiny (other legislation establishes special handling for Emergency Construction and Restoration of Damaged Facilities). Incrementation is considered to usurp the authority of Congress.

FOCUS OF CONCERN

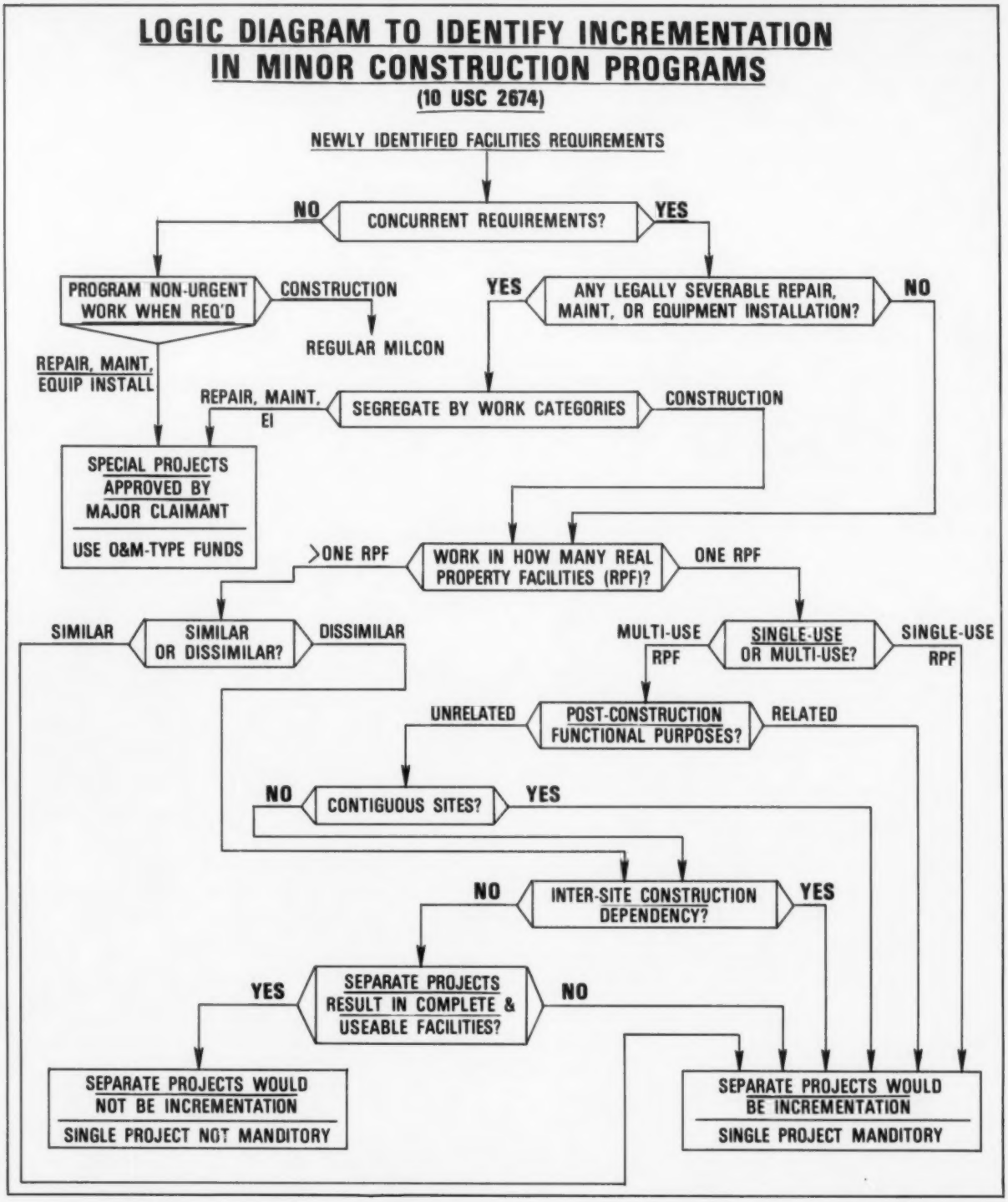
The main concerns of Congress regarding incrementation are:

- Incremental construction using multiple O&M-funded construction projects.
- Illegally supplementing Urgent Minor MILCON with O&M-funded construction projects.
- Illegally supplementing Urgent Minor MILCON or O&M-funded construction through improper charges to O&M-funded Equipment Installation Projects.

As used in this article, "O&M" includes the Operations and Maintenance, Navy (O&MN) and Research, Development, Test and Evaluation (RDT&E) appropriations, and Navy Industrial Fund accruals.

> *"While subsection (a) of section 2674, Title 10 USC, authorizes the use of appropriations available for maintenance and operations for minor (construction) projects costing not in excess of . . . (the specified upper limitation, currently $75,000) . . ., the use of such funds to pay a portion of costs directly related to a project approved by the Secretary of Defense (or Service Secretary) under subsection (b) thereof to be financed by MILCON funds is clearly improper. The O&M funds are available for Minor Construction projects only when the total cost of the complete project does not exceed . . . ($75,000)."*

Getting an Urgent Minor Construction project approved can be rough. Incrementation can only make that 'rough' job tougher.



Current Navy Department review processes are designed to forestall approval of multiple Urgent Minor MILCON projects which should be combined into a single project.

The RDT&E community has been singled out for special scrutiny by the Committee on Appropriations of the House of Representatives (HAC). Congressional investigators found what they considered to be widespread incrementation by illegal billing of construction costs to RDT&E-funded Equipment Installation Projects.

Copies of Urgent Minor MILCON projects for facilities in the research categories (Category Code Series 300) must now be provided to the HAC immedi-

ately upon approval, along with a breakout of all costs in all appropriations required to provide the complete facility. Committee intent to review the package for possible expression of congressional disagreement is apparent.

IDENTIFYING INCREMENTATION

The question of which facilities requirements must be combined into a single construction project and which may be legally subdivided into smaller projects is taken up in Chapter 3, Part 2 of OPNAVINST 11010.20C, the Facilities Projects Manual (FPM). This material is drawn almost word for word from the governing DoD directives.

The accompanying logic diagram from the OPNAV/NAVFAC Emergency Construction Office graphically portrays the interrelationships of various tests specified by the FPM to identify incrementation. A step-by-step explanation of the diagram is one way to foster an understanding of what is and is not incrementation.

CONCURRENCY

The first question in determining whether facilities requirements must be addressed as a single project is whether or not the requirements are concurrent. The new DoD Directive 4270.4 defines concurrent requirements as "requirements which, under normal circumstances, can be recognized to exist at the same time and which would be expected to be satisfied at the same time."

This appears, at first blush, to be a fairly narrow definition of concurrency. However, the phrase "at the same time" has been interpreted more broadly in the recent past and may now be presumed to encompass several months.

Congressional investigators found... widespread... illegal billing of construction costs to RDT&E... projects.

An example of congressional interpretations of "concurrency" is contained in House of Representatives Report No. 94-1231 of June 3, 1976 about two completed minor construction projects at a West Coast Naval Activity. The report concluded that:

> *. . . the submission dates of the two projects within a five-month period make it apparent the requirement(s) . . . should have been foreseen concurrently . . . this would have resulted in one project . . . requiring funding as Urgent Minor Construction . . ."*

Requirements which are known and unfunded, and which cannot be delayed for consideration in the next regular MILCON legislation, must be judged to be concurrent. The construction concept must then be subjected to further screens on the logic diagram to determine whether separate projects are allowable.

If requirements are not concurrent, separate projects may be appropriate, with each programmed at the proper time to meet the required facility delivery date. In this respect, it is proper to have an Urgent Minor MILCON project to meet the early introductory phases of a new requirement, and then follow with regular MILCON to complete the total facilities need. As long as the second step goes to Congress for approval, incrementation does not exist.

LEGALLY SEVERABLE REPAIR, MAINTENANCE AND EQUIPMENT INSTALLATION

Paragraph 3204 of the FPM provides:

> *"When Construction, Equipment Installation, Repair and/or Maintenance are accomplished simultaneously as an integrated undertaking, each separately defined category of work may be approved and funded on the basis of the separate categories. For this purpose, engineering cost estimates may be used to determine the costs applicable to each portion."*

Guidance concerning Repair, Maintenance and Equipment Installation projects are covered in Chapters 4, 5 and 6 respectively of the FPM. Special attention should be given to the fairly complex rules governing determination of what charges may properly be defined as equipment installation.

Segregation of projects by work category and fund source in accordance with this provision is perfectly legal and provides some flexibility to an otherwise fairly rigid system. If a question arises about which category of work an item fits into, it is always best to err in the direction of construction. The FPM makes this point clear by providing that:

> *"In the event a project is composed of work which is so integrated as to preclude separation of construction and repair costs, and the total funded cost of construction and repair exceeds $75,000, the combined construction/repair project shall be accomplished through funds available for MCON."*

Special Projects for Repair, Maintenance and Equipment Installation should be prepared for submission to the major claimant for approval and funding from O&M-type resources. Construction items remaining may then be screened through the additional incrementation filters.

NUMBER OF FACILITIES

The next question is whether the construction work is in one or more than one Real Property Facility. Real Property Facility (RPF) is defined as "a separate and individual building, structure or other real property improvement. An RPF shall be assigned only one three-digit basic category code (delineated in NAVFAC P-72, Category Codes for Navy Facilities Assets)."

The logic diagram follows two possible courses according to the number of RPFs involved. The option of only one RPF will be examined first.

SINGLE OR MULTI-USE

The next question is whether the one RPF is a single-use or multi-use facility. A multi-use facility is "a facility that has more than one functional purpose although assigned to one basic category code."

Functional purpose is further defined as "The use made of a real property facility or part thereof as expressed in the general terms listed as three-digit basic category codes. This applies to the purpose to be served after completion of the construction."

One must be able to identify a different facility category code (i.e., the first three digits must be

different) for each alleged separate function to qualify a facility as multi-use.

If the facility is single-use, separate projects would be incrementation. All work must be combined into a single project.

If the facility appears to qualify as multi-use, the next test for incrementation must be applied.

POST-CONSTRUCTION PURPOSES

Are the post-construction functional purposes related or unrelated? To be able to use more than one project, they must be unrelated. Related functional purposes are "Two or more functions that are normally required to carry out a specific task; and, should one of the functions be discontinued, the other function could not be accomplished."

The FPM uses administrative space within a warehouse as an example, with the qualifying assumption that the administrative tasks being performed are associated with the proper operation of the warehouse.

If the post-construction functional purposes are related, separate projects would again be incrementation. If they are unrelated, proceed to the next test.

CONTIGUOUS OR NON-CONTIGUOUS

Construction in contiguous areas of a single RPF, even if the work provides for the performance of unrelated functions in a multi-use facility, must be combined into a single project. For the purposes of this determination, contiguous is defined as "in actual contact, touching."

DoD will remain under the gun until... perception of widespread abuse has been dispelled.

INTER-SITE DEPENDENCY

Separate projects to achieve unrelated functional purposes in non-contiguous areas of a multi-use RPF are still potentially viable at this point in the review process. The next two tests examine whether the separate work packages fully meet the definition of a Construction project as contained in DoD Directive 4270.24:

> *"A single undertaking involving construction applicable to one or more real property facilities that will include all construction work, land acquisition, and items of installed equipment necessary to accomplish a specific functional purpose and produce a complete and usable facility or a complete and usable improvement to a real property facility."*

The first question is whether construction of any one of the potential projects depends on accomplishment of another. If such a dependency exists, the work must be combined into a single project. A specific example of this principle would be a chain of moves at an activity where a number of spaces have to be converted, each move being dependent upon completion of the preceding conversion in the chain.

COMPLETE AND USABLE

The final test addresses whether separate projects would produce complete and usable real property facilities. Another way to look at this question is to examine whether doing only one of the proposed projects would produce an RPF which would be fully useful. If one cannot be fully used without regard to existence of the other(s), the "complete and usable" test has failed and the work again must be combined into a single project.

On the other hand, if each of the separate projects would produce a complete and usable RPF (or improvement thereto), the use of separate projects would not be incrementation. Individual projects may then be prepared and forwarded to the applicable approval authorities. To avoid creating an impression of incrementation, however, all projects related to a given change in mission, etc., going to each approval authority should be forwarded as a package, and care should be taken to identify related projects on each DD Form 1391.

MORE THAN ONE RPF

Having walked the single RPF option through the diagram, the multiple RPF option may now be traced. There is only one test to which concurrent construction requirements in multiple RPFs must be subjected before skipping to the final project definition tests.

SIMILAR OR DISSIMILAR RPFs

Directives require that "all construction work of the same type concurrently required to be done to two or more similar RPFs at the same installation will be grouped together into a single construction project." Similarity is defined in simple and precise terms based upon facility category codes.

Similar Real Property Facilities are "Real Property Facilities having the same three-digit category code; dissimilar Real Property Facilities are Real Property Facilities having different three-digit category codes."

All concurrently required construction work to provide facilities for which the post-construction category codes will have the same first three digits must be combined as a single project. "Projects" with differing post-construction category codes pass through this screen and proceed to the "Inter-Site Construction Dependency" and "Complete and Usable Facility" tests described above.

LEGAL FLEXIBILITIES

Examining the logic diagram in summary, several perfectly legal opportunities are available for use of multiple projects. These flexibilities were purposely created by the OSD, and there is no reason to be reticent applying them. However, project initiators and reviewers must be sure compliance with tests for incrementation have been documented. Audits by the General Accounting Office with respect to incrementation must be expected, just as regular Department of the Navy financial audits and Command inspection programs already include this subject.

The Department of Defense will remain under the congressional gun on incrementation until the current perception of widespread abuses has been dispelled. While existing flexibilities should be used, the line of legality must be closely guarded to assure that these valuable flexibilities are not curtailed in reaction to congressional perceptions of abuse.

(Continued from page 7)

The environmental consultant established a modest, temporary "Navy Information" office in St. Marys — the closest town to the base. The office serves as a focal point for initial Navy representation in the vicinity. It is manned by a planner familiar with the project who also has informational brochures and various visual aids available.

The office operates on a "stroll-in" basis and this has proven popular in the intimate, small town environment. When the draft EIS is completed, the documents will be available at this office for review and public comment that will supplement the public hearings planned for the draft EIS.

SITE DESCRIPTION

MOTKI is located in Camden County on the south Georgia coast, just north of the St. Marys River which separates Georgia and Florida. Ocean access is by the St. Marys inlet, up the Cumberland Sound, formed by the barrier island containing the Cumberland Island National Seashore, to Kings Bay itself. A channel is maintained to the terminal at thirty-two feet (9.8 meters) for commercial ships now using the terminal. Excellent transportation access is available to Jacksonville, 35 miles (51.2 Km) south, and Brunswick, 40 miles (64.4 Km) north by Interstate 95.

The 9,300 acre (37.5 Km^2) site is held in fee by the Army as well as an additional 6,000 acre (24.3 Km^2) under a restrictive use easement. The site features pine plantations, marshes and swamps which are prevalent in this region of coastal Georgia. Improvements consist of a 2,000 foot (610 meter) concrete marginal wharf constructed for the Army and used by a private shipping firm under a lease which can be terminated on 90-days notice; railroad trackage and road systems and a small base support complex by the main entrance. The base has been well maintained by the Army caretaker force.

PLANNING GOALS

A Master Plan is being developed by the Installations Planning Division of NAVFAC. Several of these professional planners have backgrounds in preliminary planning for the Trident base at Bangor. The planning team set these objectives for the Master Plan: satisfy mission requirements; minimize adverse environmental impact; provide for progressive expansion potential; efficient operations; preserve regional character and natural resources; coordinate with local public planners.

THE MASTER PLAN

The first need to be met is the "T-1" case of support for the tender, ARDM and a maximum of four SSBNs alongside the tender, moorings, utilities, bachelor and married housing, personnel support facilities, medical/dental clinic, administrative and public works facilities. Master Plan development however, will be done in almost a reverse order. Rather than site "T-1" facilities at their optimum configuration, the Master Plan will instead consider the maximum development case of two Trident squadrons (A-2) with full shore refit, weapons, training, and crew homeporting which will indicate future maximum capability land use.

The Bangor base was used as a model for this purpose with minor exceptions. Near term facilities (T-1) can then be sited in such a way that relocation would be minimized if future decisions call for the more complex Trident support mission. This approach puts orderly, progressive development potential ahead of near term efficiencies and should provide a base well configured for the Navy of the future.

That is not to say it's a "gold-plated" approach but a better balancing of resources for both near term and possible long range needs. There will be a full candid discussion of this approach in the Master Plan and the draft EIS which is designed to fulfill the requirements of NEPA by discussing future potential use. The draft EIS, then, can serve for each of the several development stages with no commitment made on maximum growth.

Future supplements to the final EIS may be required if significant changes in planning warrant further environmental studies. The current draft EIS would then serve as a "baseline" EIS that could be augmented in the future in several ways. In the same fashion the Master Plan serves as the vehicle for A-95 coordination.

ABBREVIATION	DESCRIPTION
T-1	ONE C-4 BACKFIT POSEIDON SSBN, SQUADRON TENDER SUPPORTED CREWS IN EXISTING HOMEPORTS
T-2	TWO C-4 BACKFIT POSEIDON SQUADRONS ESSENTIALLY DOUBLE REQUIREMENTS OF T-2
A-1	ONE C-4/D-5 TRIDENT SUBMARINE, NO TENDER PERMANENT REFIT, WEAPONS, TRAINING, HOMEPORTING SIMILAR TO BANGOR
A-2	TWO C-4/D-5 TRIDENT SQUADRONS. SECOND SQUADRON ADDITIVE TO A-1

IMPACT HIGHLIGHTS

At this writing the extent of impact on physical, biological and socio-economic systems has not been determined. These will be detailed in the draft EIS in June, expanded after public hearings and agency review of the draft EIS and finally documented in a final EIS (FEIS) submitted to the President's Council on Environmental Quality (CEQ) in December 1977. Certain features can be characterized in advance of full analysis.

Dredging required for the project, initially about nine million cubic yards (6,840,000m^3) and some later maintenance dredging, is the most dominant ecological feature since some habitats will be affected as well as the hydrology of the bay. A companion concern will be the deposition of dredged materials which will have to be a careful balancing of economics and environmental considerations based on type of material and location.

Some potential exists for re-use of good material, such as sand, in beach nourishment. Another environmental consideration will be water quality and effects on aquatic and terrestrial wildlife. The region is rich in natural resources and contributes to a host of food chains in the ecosystem. Commercial and recreational fishing are important regional activities. Sensitivity to the continued conservation of the Cumberland Island Natural Seashore must be considered since initial indications are that no direct impact is anticipated.

Similar care must be used in minimizing use of marshes and swamps. This is expected to be minimal; construction there would be uneconomic. This article cannot detail fully the extensive monitoring, sampling and analysis of data that will be used in an exchange between environmental analysis and the Master Plan. The goal is to develop the best plan that fulfills mission needs with the least detrimental environmental impact.

Socio-economic impact will be felt in varying degrees in the entire region from Brunswick, Georgia, to Jacksonville, Florida. A model forecasting these impacts on the regional scale is being developed. Reactions to the somewhat modest scale (approximately $100 million in construction including dredging) of the project will be an indicator of growth in the region that might be associated with the Navy presence.

Camden County has a population of 12,000 with 3,400 living in St. Marys. The direct base population associated with T-1 is approximately 4,300 people including military dependents and civilians. The SSBN crews will be homeported in Charleston and New London. There will obviously be some secondary spillover into the surrounding region toward the more urbanized centers of Brunswick and Jacksonville which have greater capacity to expand housing, schools, cultural resources, etc.

Those urban centers are the major labor markets for the region. The long term projection, should a Trident base be built, is more profound, but projection is complicated by the myriad variables that time will affect. While there may be some initial transitory adjustments, the long term prospects for the region seem good since the region is dominated by the pulp and paper industries. This base and growth associated with it, should provide some economic diversification.

CONSTRUCTION

Provided the base can be transferred from the Army and the environmental process is satisfied with final approval in January 1978, construction could start in early 1978. This is predicated on congressional authorization of $19.5 million in the FY78 MCON Program. This initial funding will provide for tender and ARDM mooring, initial dredging and utility support to allow occupancy in time to match the return of the squadron from Rota by July 1, 1979.

FY79 programming will contain the balance of dredging, utilities, land acquisition, administrative, medical, public works, personnel support and 200 units of family housing. This will total approximately $55 million. FY80 will have the balance of personnel support facilities and the second increment of 200 units of family housing, bringing total project funding to an estimated $100 million for T-1. Cost estimates need to be refined as the latter programs are formulated.

SOUTHDIV will have design and construction responsibilities for the project. It is expected that an OICC will be established. The Corps of Engineers will dredge.

SUMMARY

Since its inception there has been an unfortunate short title description of this project as "Trident East" referring to MOTKI as an east coast mirror image of Submarine Base Bangor. While this is a definite possibility at some future date, this base is different in that it calls for the C-4 retrofit mission first and could grow to the full Trident base. If that does happen it will occur incrementally rather than in the more abrupt fashion of Bangor.

The question then arises of whether this is a $100 million base or a one billion dollar base? Bangor will cost over $700 million before 1980. Only the future will tell what level of development will occur at Kings Bay (or at another location if Kings Bay is not the final selected site). This article is to indicate planning and environmental considerations are being developed to provide the best information to the Navy so that it can proceed into the future better prepared to anticipate the consequences. It is the author's opinion that this is one of the best cases in recent times of such a base development.

MISSILE	NAME	RANGE	STATUS
A-1	POLARIS	1200 MI	OUT OF INVENTORY
A-2	POLARIS	1500 MI	OUT OF INVENTORY
A-3	POLARIS	2500 MI	OPERATIONAL
C-3	POSEIDON	2500 MI	OPERATIONAL
C-4	TRIDENT I	4000 MI	IN TESTING
D-5	TRIDENT II		NOT DEVELOPED

Opinion And Outlook: A View Of Military Unions

BY T. C. MURPHY
Professor Emeritus, CECOS

Since I began reading the fevered statements of those opposing unionization of the military, I've become increasingly curious about the career military man's thoughts on the matter. It might be instructive to squeeze in, between dire predictions, **his** thoughts.

I have to keep reminding myself that the current invention and promotional noise about a military union has come not from military personnel but from the AFGE, a union of civil service personnel. The target population — enlisted men of the Armed Forces — has been virtually silent.

So, to find out what they were thinking, I asked a class of 30 E6-7s attending a Navy school to write a brief paper on the question: Would a military union be a good thing or a bad thing, and why? Naturally, the students were told that their papers would not be graded.

The results are interesting.

A good thing	4
A bad thing	9
Interested, but undecided	13
Indifferent	4

But *what* they said is more interesting than the statistics, especially when set against the strident alarms of some who oppose the idea.

Rep. Les Aspin (D-Wis.) protests: "A union is out of place in the military. You can't bargain over a military commander's decision."

But is this what it's all about?

Not one of the thirty students expressed any need or desire — even remotely or by implication — for the right to interfere with the command/military function. Quite the opposite. Nine (from all sides of the question) indicated that if and when such an organization should come into being, its charter should specifically preclude such activity.

No one would claim, of course, that this tiny sample of 30 is representative of the entire military force, but it probably comes closer to being representative than the congressmen's portrayal. The disparity between the alarming spectre of rank and file voting permission to command (the congressmen's description) and the sober proscription against that possibility (by the enlisted men) makes me wonder. How well does the typical congressman know the career enlisted man?

This sample answered that question by going directly to the heart of the unionization issue, as far as they are concerned.

"Maybe a union would keep the government from slowly taking away our benefits," said one. "We might as well not have any medical benefits for our dependents. The way CHAMPUS is set up, you have to have insurance to augment it."

Another wrote, "One case in point is retirement. At this stage I do not know what retirement benefits will change before I retire."

A third said, "Representation could carry some weight in negotiations for the dwindling military benefits. The major ones being commissary closures, CHAMPUS, and bringing into being a dental program for dependents."

Another added, "I believe that the people (Congress) (sic) is forcing the military into going union and that is bad; we need their support, not their animosity. We have a job that needs to be done and if it takes a union to do that job, then the military will unionize."

One-third (10) of the respondents, from all sides of the question, expressed concern for either the prospect of diminution of their benefits or for improving them in such a way as to maintain some sort of equivalence with the private sector.

Historically, movements toward unionization have been a collective reaction to a real or an imagined institutional threat, neglect, or injury to the interests of a group. There was a considerable concern in this sample for a defense against congressional reduction of benefits; and even though there was no sentiment for a union with the whole range of traditional prerogatives, there was a very definite sympathy for a representational authority — such as a lobby — to act in the role of protector-promoter of their interests.

As the numbers above indicate, more of this sample were undecided but interested (13) than those either for (4) or against (9) the idea of a military union. Clearly, future events could move the undecideds into either camp. Very possibly, actions considered by DoD or by the Congress would push them into alignment with those who already see the union (as they define it) as a good thing; and they could then constitute a majority.

Perhaps, therefore, it would be more constructive and relevant to put away the horror scenarios and disaster signals and recognize that what many military people have in mind is something that almost every group of any consequence in our society — and some of no consequence — already has: a voice that will serve its interests effectively. Why not?

As Rep. G. V. Whitehurst (R-Va.) has said: "If there is a push for unionization, it is because efforts have been made to reduce such necessary and deserved benefits as commissaries and health care."

Unlike some of his colleagues, he hasn't been spooked. Maybe he's better informed.

"Maybe a union would keep the government from slowly taking away our benefits."

Naval Facilities Engineering Command
SITUATION REPORT

NAVFAC INDUSTRIAL ENGINEERING CENTER (NIEC) - By DOD direction, the Navy has been designated as the DOD Focal Point for Real Property Maintenance Activities (RPMA) Engineered Performance Standards (EPS) development, revision, and maintenance. The NAVFAC Industrial Engineering Center (NIEC) has been created to provide this centralized expertise. The mission of NIEC is to provide DOD components with RPMA standard time data based on latest state of the art, and maintain currency of the NAVFAC P-700 EPS manual series on a three year cycle.

The Center will be organized at the Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM), during FY77 and will become fully operational in FY78. Policy guidance and resources for the NIEC will be provided by NAVFACENGCOM. Funding will be provided by the following services: the Departments of the Army, Navy, Air Force, U. S. Marine Corps, and Defense Logistics Agency. The NIEC will be assigned to LANTNAVFACENGCOM who will provide technical direction and administrative support for personnel and logistic matters. The NIEC will be a branch in the Maintenance Division, LANTNAVFACENGCOM.

(NAVFAC Code 10)

TRACKAGE PROGRAM - The standards and procedures for inspection, certification and audit of crane and railroad trackage have been updated. NAVSEA/NAVFAC INST 11230.1 of 2 March 1977 directs U.S. Naval Shipyards, Ordnance Activities and Ships Parts Control Center, Mechanicsburg, Pa., to comply to Federal Railroad Administration Safety Standards for class two track. Other activities may find the information on degree-of-hazard classification useful in determining when trackage should not be used.

(NAVFAC Code 10)

(Continued on page 40)

Naval Facilities Engineering Command
SITUATION REPORT

INTEGRATED DISBURSING AND ACCOUNTING (IDA), THE KEY TO A BETTER CONTRACTOR PAYMENT PROCESS - As part of a Navy-wide program sponsored by NAVCOMPT, with GAO participating in a consulting role, NAVFAC is serving as the prototype for a new approach to Disbursing and Accounting, one which integrates these previously discrete functions in a single data base which serves both the fund administrator - in this case the EFD or OICC - and the disbursing officer. Under the IDA system being tested by NAVFAC, there is no longer any need to mail contract documents, contractor's invoices and contract payment vouchers from the EFD to a Navy Regional Finance Center (NRFC) for certification and payment. All hard copy documents are retained at the EFD or OICC. Accounting and Disbursing "data" are electronically transmitted to FACSO, which maintains the IDA data base. Assuming that the invoice is correct and proper for payment, as determined by appropriate computer edits and audits, the EFD/OICC Comptroller certifies the invoice for payment, FACSO produces a check for the contractor, and the Deputy Disbursing Officer (DDO), CBC, Port Hueneme, signs and mails the check. At the same time, appropriate disbursing and accounting information is entered on the data base to permit both the EFD/OICC and the DDO to perform their functions. The net effect on the contractor payment process is to reduce the time from receipt of an approved invoice in the EFD/OICC Comptroller office to mailing of a check to the contractor from a two to five week period to a three to five day period. OICC TRIDENT has been operating under IDA since July 1976 and has made over $40 million in payments. SOUTHNAVFACENGCOM is scheduled to begin paying a limited number of contracts under IDA in April. All other EFDs and OICC Bethesda are scheduled to follow in FY78.

(NAVFAC Code 01)

JOINT-SERVICE MANUAL - Maintenance and Repair of Surfaced Areas (MO-102) has recently been published and additional copies may be obtained from Naval Publications and Forms Center, Philadelphia. The manual prescribes standardized policy, criteria and procedures for the maintenance and repair of roads, streets, parking and open storage areas at DoD Component's installations. It is written for use in both operation and training.

(NAVFAC Code 10)

PUBLIC WORKS

TECHNICAL NOTES

CEL Develops Blind Fastener

The Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif., has developed a new blind-bolt fastener and a new tool to install an existing one-piece fastener. Both are designed to reduce the time-consuming assembly of underwater split pipe.

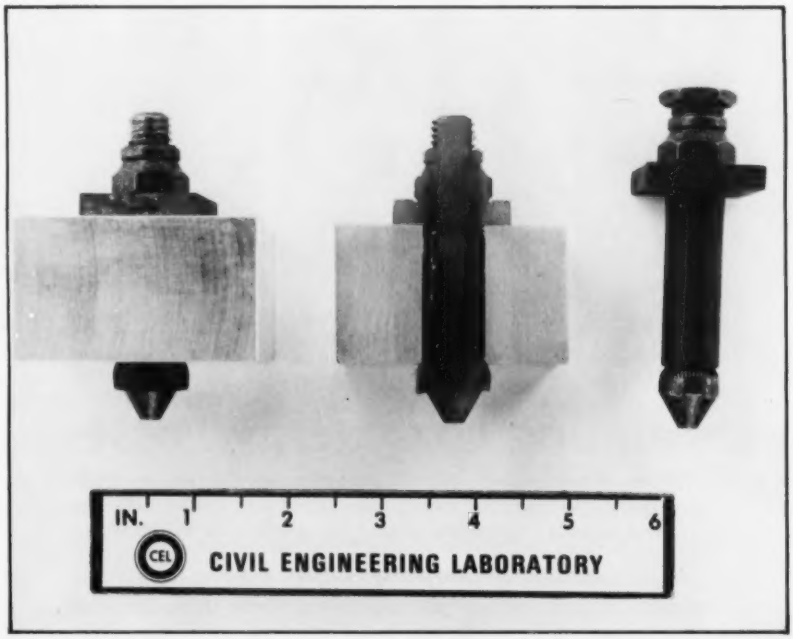
Split pipe protects underwater cables near shore. It is important that protection remain intact for long periods of time. But failure of conventional fasteners has become a major cause of frequent and costly repairs. Corrosion and vibration are two main contributors to premature breakdowns.

The present method of fastening pipe halves is with standard nuts, bolts and washers. In addition to being unreliable, this operation poses problems in lost time, repairs and maintenance. It takes about four minutes for two divers to install one three-foot (.915 meter) section of pipe. Divers often have difficulty in reaching the underside of the pipes because of sand and rock obstructions.

The Laboratory was asked to develop split pipe hardware and installation techniques that would minimize underwater assembly time and extend the life of fasteners. CEL faced two alternatives: design a new blind-bolt (one piece) fastener for split pipe; or design a new diver installation tool for an existing blind-bolt fastener. Engineers accomplished both.

A torque bolt fastening system specifically designed for split pipe was developed. Presently the fastener fits only one size, 5/8" (16 mm) diameter with a 1-1/2" (37 mm) grip length. The introduction of the CEL blind-bolt fastener is expected to make installation simpler and quicker.

The torque bolt was made commercially to Laboratory specifications. The fastener is installed as one unit using a



hydraulic torque wrench. Torquing the nut causes the central threaded mandrel to pull up through the outer sleeve. A square collar prevents the fastener from rotating on the split pipe as the nut is tightened. As the mandrel is pulled together, it expands the sleeve bottom against the work piece, locking the fastener into place. The installation nut breaks off at a predetermined torque of 800 to 900 inch-pounds. (10 meter-Kg per m^2). The completed fastener installation becomes essentially a one-piece nut and bolt assembly. Tested with two off-the-shelf fastener methods, the CEL concept proved the easiest to install.

While researching potential split pipe fasteners, it became apparent that in order to use one commercial fastening system, a

(Continued on page 44)

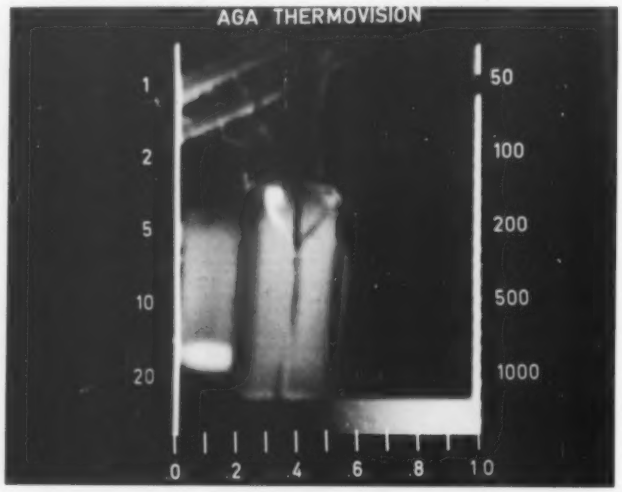
Rating Window Air Coolers For Energy Efficiency

The Energy Efficient Ratio (EER) of window air conditioning units is a reflection of the operating cost of the unit. To determine the EER, divide the watts into the BTU capacity. The higher the resulting figure, the more efficient the unit and the lower the cost of operation (energy conservation).

Direction from OASD(I&L) is that "where window type air conditioning units are installed, these units shall produce not less than 8.5 BTUs per watt input for 120 volt units and not less than 8.0 BTUs per watt for 230 volt units."

Additional information may be obtained from R. K. Middleton, Code 102H, LANTDIV; Autovon 690-7121.

PUBLIC WORKS TECHNICAL NOTES



Scanning For Energy Losses

Fast, reliable inspection of overhead electric power lines is now possible using a truck-mounted infrared scanning system. The system consists of a camera which simultaneously displays heat images on an oscilloscope screen. Heat images appear as white areas shaped like the overheated component. Overheated components can ultimately fail and cause an unscheduled outage.

Transmission and distribution lines can be examined at 15-20 miles per hour (24-32 km/hr). Upon detection of a hot spot the vehicle is stopped while a polariod picture is taken and the location and other pertinent data recorded. Substations can also be inspected using this technique.

Inspection services are conducted during the day and can be contracted.

Additional information can be obtained from Dennis M. Hannemann, Code 1022E, NAVFAC HQ; Autovon 221-0362.

How To Put A Building Into Long Term Storage

Layway of buildings is indicated when an active period of two years or more is expected after lay-up is completed. Measures to be taken include:

- Repair and/or replacement of base, damaged or missing building shell components and roof repairs essential for weather-proofing.
- Attention to ventilating requirements.
- Prevention of corrosion and freezing.
- Identification and storage of accessories.
- Maintenance of security and fire protection.

Procedures are detailed in NAVFAC MO-300, Inactivation of Facilities.

Additional information may be obtained from A. S. Gallup, Code 102A, LANTDIV; Autovon 690-7121.

'Raincoats' for Showers?? You Betcha...And For Laundries!

Wet areas such as showers and laundries require hard, impervious, moisture-resistant and mildew-resistant coatings which can withstand water, soap and detergents. This subject is addressed in NAVFAC MO-110, "Paints and Protective Coatings," Chapter 10.

The following coatings are suggested for such areas where enamels will not suffice: TT-P-95, Rubber Base Paint, either gloss or semi-gloss; TT-C-535, Epoxy Coating; TT-C-542, Polyurethane Coating, Moisture Curing; and TT-C-550, Glaze Coating.

Tables 10 through 12, Appendix D-4 of MO-110, list complete paint systems according to the substrate to be painted. Surface preparation is of utmost importance. (See Section 3, Chapter 10 of MO-110.)

In addition to normal surface preparation procedures, special attention must be given to removal of all traces of soap, detergent and mildew. Also, the compatibility of the above recommended paints with the existing painted surfaces must be determined. These paints contain strong solvents which may soften the existing coating resulting in lifting, wrinkling and peeling. Small trial areas should be painted and observed for a suitable period of time to ascertain compatibility.

Manufacturers' representatives should be consulted on the use of their products and for recommendations as to compatibility, surface preparation, need for special primer, application procedures, etc. Additionally, shower rooms must have adequate ventilation to reduce condensation.

Additional information may be obtained from A. S. Gallup, Code 102A, LANTDIV; Autovon 690-7121.

PUBLIC WORKS TECHNICAL NOTES

...to shed the least possible light...

A light dimmer whose sensitivity can be adjusted to detect the presence of an added shadow in a room has been developed at the Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif.

The Constant Illumination Level Lighting System Control is one of the first automatic dimming lighting control systems available. The device is simple to operate and offers the potential of tremendous savings in kilowatt hours (KWH) and expenditures.

To operate, a person merely pre-sets the illumination (lighting) level at the level he desires. The system is then placed on "automatic," assuring occupants of the room the desired amount of illumination, a combination of natural and artificial lighting.

The control consists of a photocell sensor, input amplifier, level-setting comparator, multi-indicator, electro-mechanical driver, and a dimmer. Components are solid state and designed for long life. The sensor (size of a thumb nail) is installed in the ceiling of the room with controlled lighting. The rest of the unit, measuring 9"x12"x4" (22.9 cm x 30.5 cm x 10.2 cm) can be located near a power panel or recessed into a wall.

When the control is initially turned on, the automatic-set switch is positioned to "set." A bright or dim button is pushed until the desired lighting is provided by the system. A null potentiometer is adjusted until a null is shown on the indicator. At this point, the automatic-set switch is placed on "automatic."

If the light level increases above the desired setting, the sensor sends a signal to the input amplifier. The output voltage of the input amplifier is compared by the comparator with the reference voltage established by the potentiometer. The comparator signals the electro-mechanical drive to lower the dimmer. As the lighting system is dimming, the signal from the sensor is changing which causes the output voltage of the amplifier to change.

Many light deflections go unnoticed by persons in the room because the change must be about 10 foot-candles (3 meter-candles) before the human eye detects it. For example, the sensor will react if a person wearing a white shirt walks beneath it. But the change in the light level would not be observed by anyone.

To support the logistics of this concept, a hypothetical economical analysis was developed. The lighting system was applied to five major cities: Indianapolis, Los Angeles, Miami, Minneapolis, and Washington, D.C. A five-year average of sunny, cloudy, and partly cloudy days was compiled, based on five eight-hour work days.

In compiling the data, the installation of 100 luminaires (light fixtures) and a complete lighting control unit was used as a single point of reference. Each luminaire consisted of two 48-inch (123 centimeter), 40-watt fluorescent lamps. In determining costs of KWH, the CEL going rate of 3.3 cents was used. The figures show that Indianapolis (with the control) would save 11,200 KWH per year, compared to savings of 13,829 KWH in Los Angeles. In dollars, Indianapolis would save $396.36 per year per 100 luminaires. Los Angeles would save $482.76 in one year. Miami would save 12,344 KWH, Minneapolis, 11,429, and Washington, D.C., 11,600 KWH, or $407.35, $387.16 and $382.80 respectively.

A prototype of the Constant Illumination Level Lighting Control System is on display at Lawrence Hall of Science, University of California at Berkeley, through the summer of 1977. The CEL display is part of an exhibition of energy conservation devices sponsored by the Energy Research and Development Agency and is open to the public.

For additional information, contact M.N. Smith, Code L62, Civil Engineering Laboratory, Autovon 360-4796.

How Does Your Battery Rate?

The following battery ratings came into general use in 1972. They can help you determine what is the right sized battery for your equipment.

- **Cold-Cranking Capacity.** This is simply the number of amps the battery can put to your starter at zero degrees fahrenheit (-18°C); but how big a battery do you need? Simple, match your engine's displacement and the cold-cranking capacity. In cold climates add another 20 percent. For example: If you are stationed in Maine and have a 350 C.I.D. engine, you need a basic cold cranking capacity of at least 350 amps plus an extra 20 percent or 70 more amps. In other words, ignore warranty and price, but get a battery with a total cold-cranking rating of not less than 420 amps.

- **Reserve Capacity.** This number tells you how many minutes your engine can keep running at night if your alternator happens to go out. This figure is calculated for a standard 25 amp load, i.e., about what is required to run a car on an 80 degree night, including lights, wipers, other accessories and ignition. In other words, if the reserve rating is 90 you can drive for approximately 90 minutes on a balmy night without your alternator before your car quits.

Additional information may be obtained from Civil Engineer Support Office Maintenance Bulletin, 22 May 1976; call Autovon 360-4627 or 360-5348.

Inspections Via Television

PENSACOLA 4730.2 outlines procedures for obtaining services of the telespection system; a closed circuit television inspection system. This equipment was designed as a highly versatile TV system, used primarily for internal inspection of sanitary sewers.

The closed circuit TV system employs a TV camera which converts the optical scene to an electrical output that can be transmitted over a cable and recreated on a TV screen, including special lighting for the camera. The system is designed to operate from a 117-V AC source. Up to 1,000 feet of cable can be accommodated by the special reel which provides a picture with resolution and detail approximately twice that of the standard home TV receiver.

Additional information may be obtained from William Hunter, Code 430, PWC Pensacola; Autovon 922-3643.

Keep Linoleum Problems From Getting Underfoot

A Beneficial Suggestion describes a technique whereby one man, in thirty minutes, can repair torn, separated, and curled linoleum surfaces or reglue linoleum seams on kitchen floors. This simple process reduces the task of tearing out and replacing large sheets of linoleum and can provide a substantial savings in time, labor, and material (linoleum, adhesive, etc.).

- Thoroughly clean area to be glued with cleaning agent (steel wool, soap, detergent, etc.).
- Peel back seam as far as possible to allow sufficient quantities of adhesive to be applied.
- Apply heat resistant "Duct Tape" the entire length of seam. This tape should be two inches wide to provide sufficient pressure on both sides of linoleum seam. Wherever necessary, tape should be laid down at ninety degree angles to seam on those places that are badly torn or curled.
- After tape has been placed, and sufficient pressure applied to keep the linoleum in place, heat entire length of seam with a butane torch. This procedure guarantees adhesion at those places that are obstinate and refuse to stick down. The asbestos tape is the "secret" of this technique. It allows the linoleum to be held in place, and it allows the worker to apply intensive applications of heat without scorching the linoleum. The heat treatment also helps to conform the linoleum to any irregularities in the floor and guarantees adhesion.
- Leave tape on floor for approximately three hours and then remove and clean up with appropriate material.

Activities that try this technique are requested to advise the Naval Facilities Engineering Command, Code 1013, of their success or adoption of this suggestion.

Additional information may be obtained from J. J. Leimanis, Code 10133, NAVFAC HQ; Autovon 221-8182.

CEL Develops Blind Fastener

(Continued from page 41)

completely new installation tool would have to be designed. The existing tool prevents proper installation. It is triggered through an electronic solenoid which is undesirable for underwater use, and the ejector system interferes with the pipe flange which also prevents proper installations.

Designed to provide a convenient workable diver tool for installation of blind one-piece fasteners, the CEL version consists of a hydraulic ram assembly, tool adaptor assembly, and hydraulic control assembly. The tool works by pulling a central mandrel up through the outer sleeve with a hydraulic ram. The CEL concept features a hollow piston which allows each spent mandrel to be shoved up, through and out the back of the tool. This improvement offers two distinct advantages: without the need for an ejector, the nose piece could be shaped to fit the recess of the split pipe flange; and with a hollow piston, a bolt of any length could be used since the bolt mandrel could extend up inside the piston.

The Laboratory is conducting a long-range evaluation of blind-bolt fasteners. A total of 600 was installed on split pipe at a depth of 40 feet (12.2 meters) in the ocean. The system will be inspected twice a year for five years. The ocean tests were started after detailed in-house tests were conducted with satisfactory preliminary results.

The improved method of using blind-bolt fasteners has many potential applications such as salvage work (placing attachment points, padeyes), underwater structures requiring fastening by divers (I-beams, plates) and various underwater repair operations. In many instances, blind-bolts could prove stronger and more durable than nuts and bolts.

The following criteria must be met to develop an acceptable fastener installation: quick and simple installation; as few parts as possible; access required from only one side of the pipe; strong enough to hold pipe halves together under all conditions; resist loosening (vibration) even if the pipe partially corrodes; and made of corrosion-resistant material or be cathodically protected by sacrificial anodes.

For additional information, contact R. L. Brackett or Wayne Tausig, Code L43, Civil Engineering Laboratory, Autovon 360-5470.

(Continued from page 27)
properly installed and concrete consolidation had been achieved.

Most dismantling work was done during the second phase of the project. During this plase the reactor buildings and the five steel reactor containment tanks were removed. The reactor containment tanks were installed in a 30 ft. (9.1 meter) deep excavation and were covered by compacted, crushed rock backfill. The backfill had to be removed to gain access to the tanks.

However, it was not a typical excavation job. The backfill material was frozen and could not be broken up readily. It was also radioactively contaminated and had to be worked with great care to minimize spread of radioactive dust which was both a health hazard and potential pollutant of the Antarctic environment.

The upright tanks were 8 ft. (2.4 meters) in diameter by 35 ft. (10.7 meters) high and had to be lowered to horizontal for removal. Loads were unevenly distributed within the tanks and the center of gravity and exact weights were unknown and impossible to calculate. The excavation in which the tanks were located was extremely confining and there was no room in which to maneuver equipment.

Also, the tanks contained large quantities of radioactive material and had to be handled with extreme care. The tanks were successfully lowered and removed using a 55-ton (50,000 kg) mobile crane. Actual tank weight ranged from 30,000 to 92,000 pounds (13,600 to 41,800 kg). The tanks were extremely well preserved considering they had been in the ground since 1962. Original markings were clearly legible, and after a minor cleaning, the tanks looked like new.

The third year of dismantling operation began Oct. 16, 1975. Major projects included removal of the condenser building and final site cleanup. A comprehensive radiological survey of the PM-3A site was made using a standard PRN-5N scaler with an SPA-3 probe, which is an extremely sensitive instrument capable of detecting low levels of contamination. Soil and rock found contaminated were excavated and staged for shipment. Some 6,500 cubic yards (5,000 cubic meters) of soil and crushed rock were contaminated.

To verify results of the site survey, 480 soil samples were collected at random and returned to the U.S. for analysis. Because the Deep Freeze resupply ship arrived late and the ice wharf was not in good condition, it was not possible to ship the contaminated soil and rock during the Deep Freeze 76 season as planned.

During the three Deep Freeze austral summer seasons, some 900 tons (815 metric tons) of radioactive waste and 115 tons (104 metric tons) of non-contaminated retrograde were removed from the PM-3A site. The radioactive waste included irradiated nuclear fuel, special nuclear material and the reactor pressure vessel. The material was shipped to CONUS where it was off-loaded and trucked to a licensed radioactive waste disposal site.

Three shipments were made and, in terms of number of packages and total weight, the PM-3A shipment represents the largest quantity of radioactive waste ever transported from Antarctica and certainly ranks as one of the largest radioactive waste shipments in the nuclear power industry.

Deep Freeze 77 austral summer efforts will include removal of the remaining contaminated soil, final cleanup of the PM-3A complex, and an extensive site survey by an independent agency to verify that the PM-3A dismantling project has been accomplished in accordance with the requirements of the Antarctic Treaty.

HOT — The reactor pressure vessel had to be encased in a concrete and steel shield before it could be safely shipped. The upper 20 ft. (6.1 meters) of the containment tank was cut off to save weight. The container still weighed 46 tons (42,000 kg).

The Civil Engineer Corps Welcomes Graduates of Basic Class 142, Naval School, Civil Engineer Corps Officers

Front row, L to R — ENS Willie Bender, BS (BioEngr) Miss. State, to NAS Key West, Fla.; ENS Eugene Thies, BSCE Nebraska, to NAS Lakehurst, N.J.; ENS Richard Hunter, BSCE Lehigh Univ., to NAS Oceana, Va.; ENS Jerry Jensen, BSME, Nebraska, to NAVSTA Adak, Ak.; LTJG John Calamari, MSCE, N.Y. Poly. Inst., to COMOCEANSYSPAC Pearl Harbor, Hi.; LT Gilbert Lappano, MSCE Pittsburgh, to NAS Cecil Field, Fla.; ENS Gary Asztalos, BSCE Drexel Univ., to NETC Newport, R.I.; ENS Mark Huntzinger, BSCE New Jersey Inst. of Tech., to MCAS Cherry Point, N.C.; ENS John Rand, BSCE New Mexico, to NMCB-1; ENS Kazimiras Narbutatis, BSCE Cleveland State, to PWC Great Lakes, Ill.; ENS Albury Gardner, BSCE Purdue, to NAVORDSTA Louisville, Ky.; **2nd row, L to R** — ENS James Barrett, BS Arch, Virginia, to NAS Memphis, Tenn.; LTJG Oliver Barfield, MA Arch. Oklahoma, to AROICC Misawa, Japan; ENS Courtney McCracken, BS Arch. MIT, to NAF Atsugi, Japan; ENS Gus Lott, BS (Elect. Engr.) Auburn, to NAS Corpus Christi, Tex.; ENS Charles Bergson, BSCE U.C. Berkeley, to AROICC, Quantico, Ca.; ENS Ross Schlobohm, BSCE West Virginia, to PWC Norfolk, Va.; ENS Larry Goshorn, BSCE Colorado, to Annapolis, Md.; ENS Michael Bondor, BSCE Case Western Reserve, to NSA Brooklyn, N.Y.; **Back row L to R** — ENS Thomas Hilferty, BSCE Drexel Univ., to NMCB-4; ENS Brian Silas, BS (Bldg. Const.) Fla., to NMCB-62; ENS Joseph Hall, BSCE Texas to NSF Anatarctica; LTJG Eugene Spencer, BSCE Arizona State, to AROICC Earle, N.J.; ENS Gerard Tyra, BS Engr. Science Purdue, to NTC Orlando, Fla.

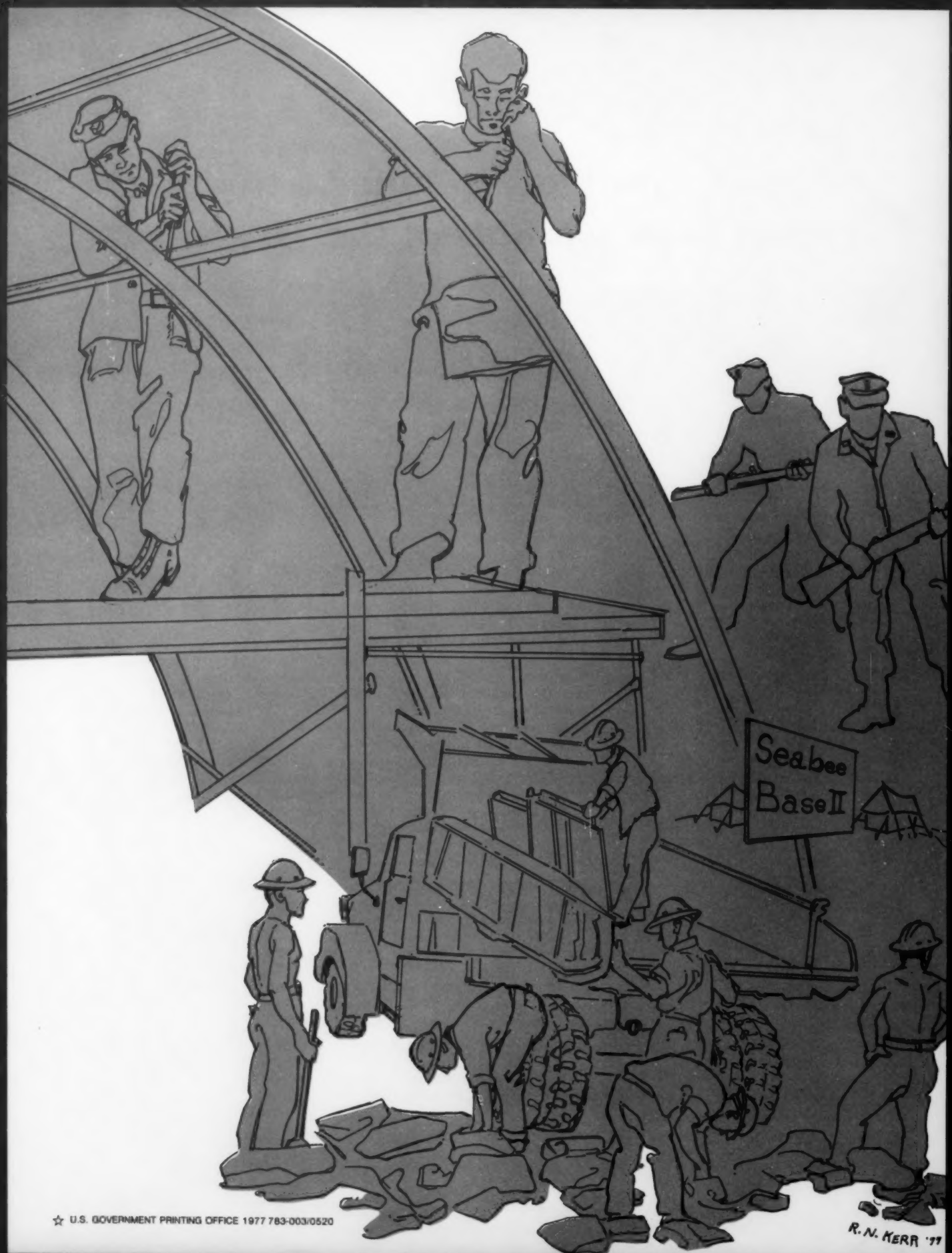
An invitation to young graduate engineers to join the young professionals of the U.S. Navy

CIVIL ENGINEER CORPS

Construction and maintenance of the Navy's shore and support installations is just one of the responsibilities of the engineer managers of the Navy's Civil Engineer Corps. And qualification is not limited to the civil engineering discipline, as the Corps requires graduate engineers of mechanical, chemical, electrical, industrial and construction disciplines and architecture too! As a commissioned officer of the U.S. Navy the young engineer is offered greater opportunity to develop quickly a professional career with the added potentialities of an exciting overseas assignment, professional registration and graduate studies! The young officer may be assigned to construction contract administration, public works management or with a Naval Mobile Construction Battalion, the historic Seabees, plus many individual and unique positions.

Engineering students and counselors are invited to explore the multifaceted world of the Navy's Civil Engineer Corps by contacting their local Navy Recruiter for specific details. An informal visit with a Civil Engineer Corps officer to discuss the personal and professional benefits of a Navy career can be arranged by the same Navy recruiter or by calling or writing the Naval Facilities Engineering Command, (ATTN Code 09MA1), 200 Stovall Street, Alexandria, Va., 22332 Telephone: (202) 695-3635.

Call toll-free 800-841-8000 now if you desire instant information from the Naval Recruiting Command. If you're a good student, and want to be a better engineer, the chances are you'll do best by investigating the Civil Engineer Corps of the U.S. Navy.



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